

**This is a scanned version of the text of the original Soil Survey report of Bonneville County Area, Idaho issued July 1981. Original tables and maps were deleted. There may be references in the text that refer to a table that is not in this document.**

**Updated tables were generated from the NRCS National Soil Information System (NASIS). The soil map data has been digitized and may include some updated information. These are available from <http://soildatamart.nrcs.usda.gov>.**

**Please contact the State Soil Scientist, Natural Resources Conservation Service (formerly Soil Conservation Service) for additional information.**

## Foreword

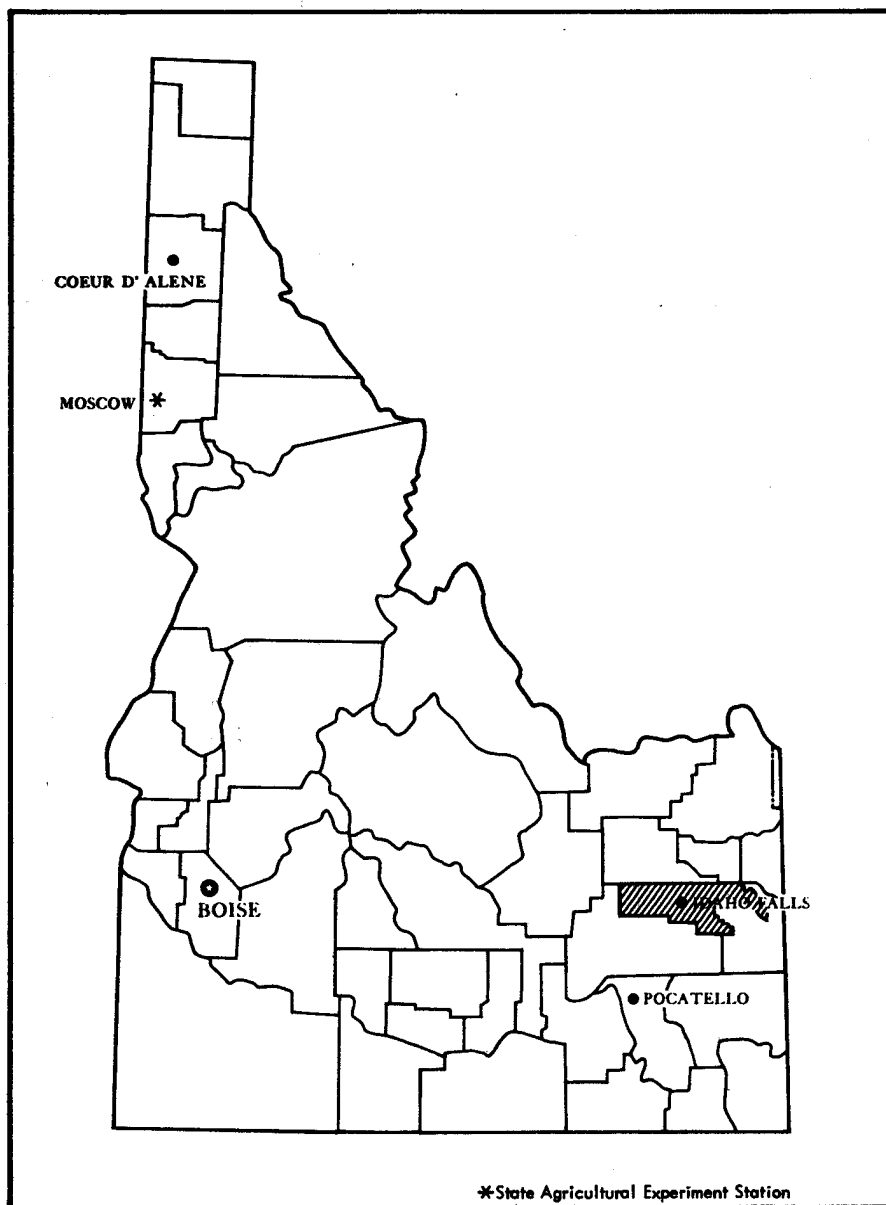
This soil survey contains information that can be used in land-planning programs in Bonneville County Area, Idaho. It contains predictions of soil behavior for selected land uses. The survey also highlights limitations and hazards inherent in the soil, improvements needed to overcome the limitations, and the impact of selected land uses on the environment.

This soil survey is designed for many different users. Farmers, ranchers, foresters, and agronomists can use it to evaluate the potential of the soil and the management needed for maximum food and fiber production. Planners, community officials, engineers, developers, builders, and home buyers can use the survey to plan land use, select sites for construction, and identify special practices needed to insure proper performance. Conservationists, teachers, students, and specialists in recreation, wildlife management, waste disposal, and pollution control can use the survey to help them understand, protect, and enhance the environment.

Great differences in soil properties can occur within short distances. Some soils are seasonally wet or subject to flooding. Some are shallow to bedrock. Some are too unstable to be used as a foundation for buildings or roads. Clayey or wet soils are poorly suited to use as septic tank absorption fields. A high water table makes a soil poorly suited to basements or underground installations.

These and many other soil properties that affect land use are described in this soil survey. Broad areas of soils are shown on the general soil map. The location of each soil is shown on the detailed soil maps. Each soil in the survey area is described. Information on specific uses is given for each soil. Help in using this publication and additional information are available at the local office of the Soil Conservation Service or the Cooperative Extension Service.

Amos I. Garrison  
State Conservationist  
Soil Conservation Service



Location of Bonneville County Area in

# soil survey of Bonneville County Area, Idaho

United States Department of Agriculture  
Soil Conservation Service in cooperation  
with

University of Idaho, College of Agriculture  
Idaho Soil Conservation Commission

By Ray L. Miles, Soil Conservation Service

Fieldwork by Ray L. Miles, Soil Conservation Service, and  
Jack O. Harwood and Mike J. Zielinski, Idaho Soil Conservation Commission

BONNEVILLE COUNTY AREA is in southeastern Idaho. It has a total area of 602,000 acres, or 941 square miles. Idaho Falls, the county seat of Bonneville County, has a population of about 40,000.

The survey area is mainly on the Snake River Plain. The eastern part is the Caribou Range. The western part of the area is loess-covered basalt flows. The loess-covered basalt and rhyolite foothills east of Idaho Falls are cut by deep canyons.

The Snake River is the major stream in Bonneville County Area. It flows northwesterly from the Wyoming border and southerly through the central part of the area. Flood plains are adjacent to the Snake River. Elevation ranges from about 4,600 feet along the Snake River to about 8,000 feet in the mountainous areas.

Descriptions, names, and delineations of soils in this soil survey do not fully agree with those on soil maps for adjacent counties. Differences are the result of better knowledge of soils, modifications in series concepts, intensity of mapping, or the extent of soils within the survey.

## General nature of the area

This section provides general information about Bonneville County Area. It discusses history and development, natural resources, farming, and climate.

## History and development

Bonneville County was established on February 7, 1911, when the Idaho State Legislature approved the division of Bingham County. Bonneville County was

formed from the northern part of Bingham County. It was named in honor of Captain B. L. E. Bonneville of the United States Army, one of the early explorers of the area.

Idaho Falls, the county seat of Bonneville County, was known as Eagle Rock until August 26, 1891. A ferry and the J. M. (Matt) Taylor log toll bridge, built in 1864-65, accelerated the growth of Idaho Falls by furnishing transportation across the Snake River and concentrating commerce. By 1880 a permanent community based on agriculture had been established. The growth and development of Bonneville County Area have been steady because it is the central trading area for 12 surrounding counties. The population of Idaho Falls has grown from 9,429 in 1930 to about 40,000 at present. Continued growth is expected.

The first settlers used irrigation for farming because of the arid climate. Canals at first were constructed by hand- and horse-drawn equipment, but as more settlers arrived, construction equipment was improved and canals and ditches were expanded. In recent years sprinkler irrigation has been used on the nearly level terraces between the Snake River and the nearby rolling uplands.

There are two Soil Conservation Districts in Bonneville County Area. The West Side Soil Conservation District was formed in August 1944, and the East Side Soil Conservation District was formed in July 1948. These districts are separated by the Snake River.

The Idaho National Engineering Laboratory has attracted many highly skilled workers to Idaho Falls.

## Natural resources

Bonneville County Area consists mainly of soils that are well suited to farming. Grazing land is administered mainly by the United States Department of the Interior, Bureau of Land Management.

Several pits in the area are mined for pumice, which is used for making concrete building blocks. Some drilling for oil and gas has been done, but no fields have been commercially developed because of their limited size and productivity. At the present time, exploration for oil is extensive in the survey area.

The Snake River produces electrical power through the Palisades Dam and Idaho Falls hydroelectric power plants.

Gravel and sand for roads and other construction are abundant in the survey area.

## Farming

The main cash crops grown in Bonneville County Area are grain, alfalfa, hay, potatoes, and sugar beets. Yields are limited by the short growing season.

Most farms raise dairy cattle, beef cattle, sheep, and hogs. Horses are also raised, mainly for pleasure riding. Livestock is important to the economy of the area.

## Climate

Prepared by the National Climatic Center, Asheville, North Carolina.

The Rocky Mountains partially shield Bonneville County Area from strong arctic winds. Winters generally are cold, but not severe. In summer, winds from the Pacific Ocean are partially blocked. Days are hot, and nights are cool. Precipitation is low in summer, except in mountainous areas. In many places precipitation is adequate during the cooler part of the year for nonirrigated small grain and range plants. The melting of the snowpack at higher elevations supplies irrigation water for intensive farming in part of the lowland.

Table 1 gives data on temperature and precipitation for the survey area as recorded at Idaho Falls, Idaho, in the period 1951 to 1973. Table 2 shows probable dates of the first freeze in fall and the last freeze in spring. Table 3 provides data on length of the growing season.

In winter the average temperature is 22 degrees F, and the average daily minimum temperature is 14 degrees. The lowest temperature on record, which occurred at Idaho Falls on January 12, 1963, is -33 degrees. In summer the average temperature is 66 degrees, and the average daily maximum temperature is 82 degrees. The highest recorded temperature, which occurred on July 20, 1960, is 101 degrees.

Growing degree days are shown in table 1. They are equivalent to "heat units." During the month, growing degree days accumulate by the amount that the average temperature each day exceeds a base temperature (40

degrees F). The normal monthly accumulation is used to schedule single or successive plantings of a crop between the last freeze in spring and the first freeze in fall.

Of the total annual precipitation, 5 inches, or 60 percent, usually falls in April through September, which includes the growing season for most crops. In 2 years out of 10, the rainfall in April through September is less than 4 inches. The heaviest 1-day rainfall during the period of record was 1.48 inches at Idaho Falls on July 19, 1973. Thunderstorms occur on about 20 days each year, and most occur in summer.

Average seasonal snowfall is 32 inches. The greatest snow depth at any one time during the period of record was 20 inches. On an average of 35 days, at least 1 inch of snow is on the ground. The number of such days varies greatly from year to year.

The average relative humidity in midafternoon is about 40 percent. Humidity is higher at night, and the average at dawn is about 70 percent. The sun shines 80 percent of the time possible in summer and 40 percent in winter. The prevailing wind is from the southwest. Average windspeed is highest, 11 miles per hour, in spring.

## How this survey was made

Soil scientists made this survey to learn what soils are in the survey area, where they are, and how they can be used. They observed the steepness, length, and shape of slopes; the size of streams and the general pattern of drainage; the kinds of native plants or crops; and the kinds of rock. They dug many holes to study soil profiles. A profile is the sequence of natural layers, or horizons, in a soil. It extends from the surface down into the parent material, which has been changed very little by leaching or by plant roots.

The soil scientists recorded the characteristics of the profiles they studied and compared those profiles with others in nearby counties and in more distant places. They classified and named the soils according to nationwide uniform procedures. They drew the boundaries of the soils on aerial photographs. These photographs show trees, buildings, fields, roads, and other details that help in drawing boundaries accurately. The soil maps at the back of this publication were prepared from aerial photographs.

The areas shown on a soil map are called map units. Most map units are made up of one kind of soil. Some are made up of two or more kinds. The map units in this survey area are described under "General soil map for broad land use planning" and "Soil maps for detailed planning."

While a soil survey is in progress, samples of some soils are taken for laboratory measurements and for engineering tests. All soils are field tested to determine their characteristics. Interpretations of those characteristics may be modified during the survey. Data are assem-

bled from other sources, such as test results, records, field experience, and state and local specialists. For example, data on crop yields under defined management are assembled from farm records and from field or plot experiments on the same kinds of soil.

But only part of a soil survey is done when the soils have been named, described, interpreted, and delineated on aerial photographs and when the laboratory data and other data have been assembled. The mass of detailed information then needs to be organized so that it can be used by farmers, rangeland and woodland managers, engineers, planners, developers and builders, home buyers, and others.

## General soil map for broad land use planning

The general soil map at the back of this publication shows broad areas that have a distinctive pattern of soils, relief, and drainage. Each map unit on the general soil map is a unique natural landscape. Typically, a map unit consists of one or more major soils and some minor soils. It is named for the major soils. The soils making up one unit can occur in other units but in a different pattern.

The general soil map can be used to compare the suitability of large areas for general land uses. Areas of suitable soils can be identified on the map. Likewise, areas where the soils are not suitable can be identified.

Because of its small scale, the map is not suitable for planning the management of a farm or field or for selecting a site for a road or building or other structure. The soils in any one map unit differ from place to place in slope, depth, drainage, and other characteristics that affect management.

In the following pages the map units in this survey area are described.

## Descriptions of map units

### 1. Lava flows-Polatis

*Lava flows and undulating, moderately deep, well drained soils; on basalt plains*

This map unit is in the southwestern part of the survey area near Bingham County. Elevation is 4,600 to 5,400 feet. The average annual precipitation is about 10 inches, the average annual air temperature is 43 degrees F, and the frost-free season is 95 to 120 days.

This map unit makes up about 10 percent of the survey area. It is about 90 percent Lava flows and 5 percent Polatis soils. The remaining 5 percent is soils of minor extent.

Lava flows are dominantly bare rock. Soil material is in cracks and crevices in some areas of Lava flows. Polatis

soils are moderately deep silt loams over basalt. Lime accumulations are above the basalt (fig. 1).

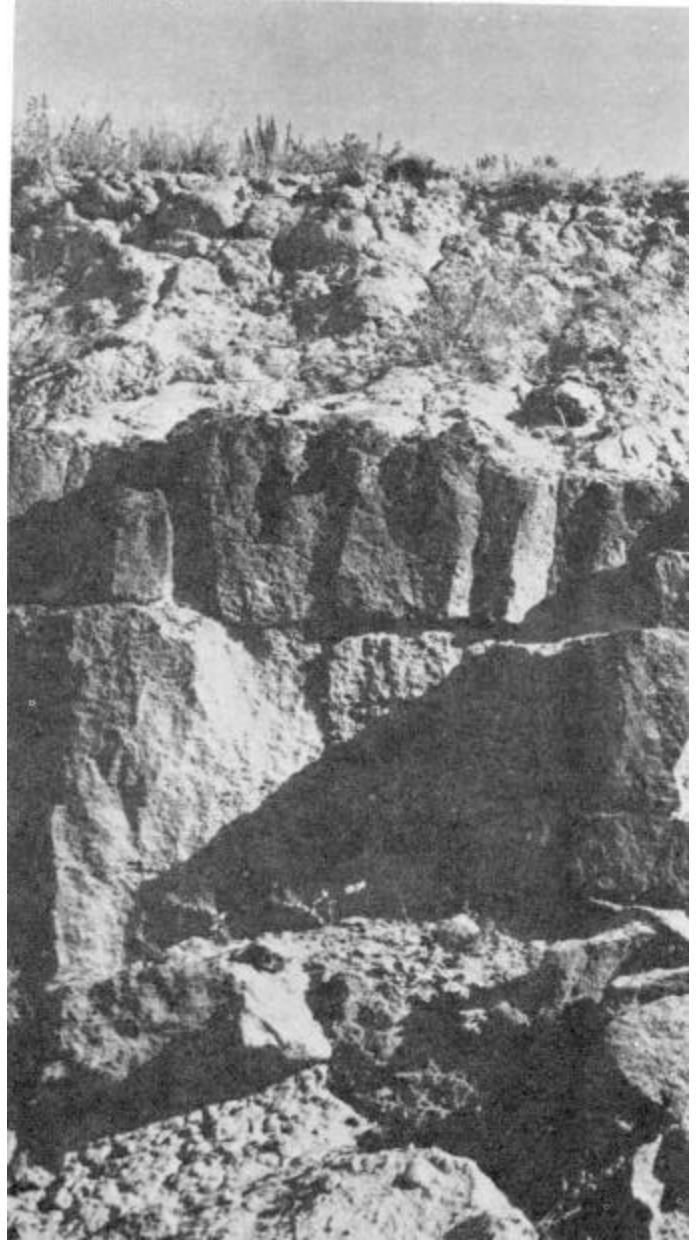


Figure 1.-Profile of Polatis silt loam. Basalt is at a depth of 20 to 40 inches.

Of minor extent in this unit are well drained Pancheri soils and a soil that is similar to Polatis soils but has bedrock at a depth of less than 20 inches. Pancheri soils are very deep silt loam.

This unit is used mainly as rangeland and for wildlife habitat. It is limited for most other uses by lack of soil

material on the Lava flows and by lack of readily available water.

## 2. Pancheri-Polatis

*Nearly level to steep, moderately deep and very deep, well drained soils; on basalt plains*

This map unit is in an area that extends from west of the Snake River to the Bingham County line. Elevation is 4,600 to 5,400 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 95 to 120 days.

This unit makes up about 22 percent of the survey area. It is about 75 percent Pancheri soils, 15 percent

Polatis soils, and 5 percent Rock outcrop. The remaining 5 percent is soils of minor extent.

Pancheri soils are very deep and are silt loam throughout. Polatis soils are moderately deep silt loams over basalt. Rock outcrop is exposed areas of basalt.

Of minor extent in this unit are playas, soils that are similar to Pancheri soils but have a clayey substratum, and soils that are similar to Polatis soils but have bedrock at a depth of less than 20 inches.

This unit is used mainly for sprinkler-irrigated grain and potato crops, but some areas are used as rangeland and for wildlife habitat (fig. 2).

This unit is well suited to irrigated crops, especially those crops that are adapted to cool climates. It is well

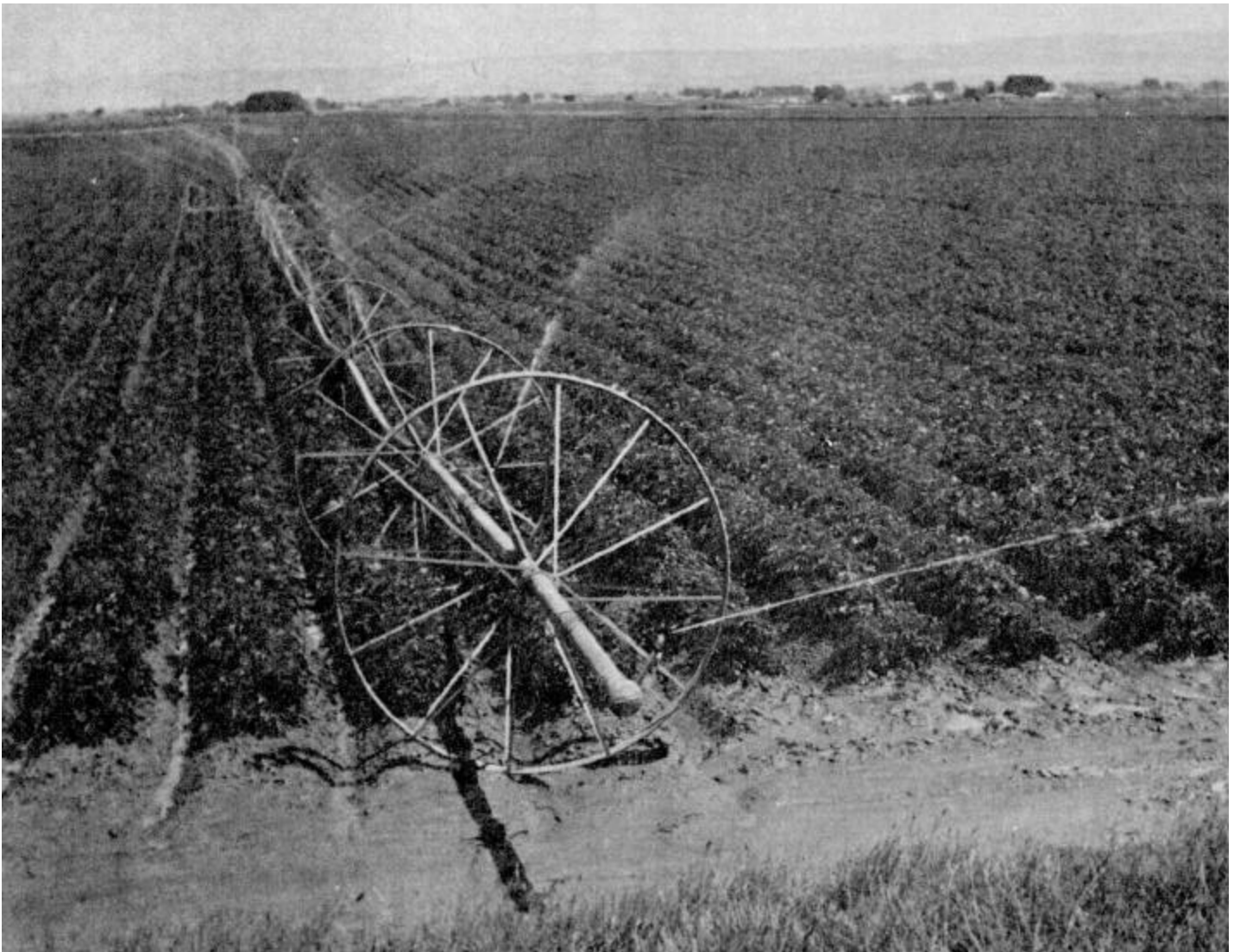


Figure 2.-Sprinkler-irrigated potatoes on Pancheri silt loam, 2 to 4 percent slopes.

suited to development of habitat for game birds. This unit is well suited to urban development. Special design of septic tank absorption fields is needed because the soils are moderately permeable.

### **3. Bannock-Paese**

*Nearly level, very deep, well drained soils; on flood plains*

This map unit is in the central part of the survey area along the Snake River. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 90 to 120 days.

This unit makes up about 15 percent of the survey area. It is about 30 percent Bannock soils, 25 percent Paul soils, 10 percent Paese soils, and 10 percent Packham soils. The remaining 25 percent is soils of minor extent.

The Bannock soils have a surface layer of loam, a subsoil of silt loam, and a substratum of gravelly loam. Extremely gravelly coarse sand is at a depth of 20 to 40 inches. The Paul soils have a surface layer and subsoil of silty clay loam and a substratum of silt loam. Very gravelly coarse sand is below a depth of 40 inches. The Paese soils have a surface layer and subsoil of silty clay loam. Very gravelly loamy coarse sand is at a depth of 20 to 40 inches. The Packham soils have a surface layer of gravelly loam and very gravelly loam and a subsoil of very gravelly loam. Extremely gravelly loamy sand is below a depth of 20 inches.

Of minor extent in this unit are Wolverine, Heiseton, Harston, Bock, Ammon, and Stan soils. The Wolverine soils are sand dunes on the valley floor. The Heiseton soils are fine sandy loam throughout. The Harston, Bock, and Stan soils are loamy, and the Ammon soils are silty.

This unit is used mainly for irrigated grain, potatoes, sugar beets, and alfalfa.

This unit is well suited to most irrigated crops, especially those that are adapted to cool climates. Gravel deposits near the surface, which cause droughtiness and make tillage difficult, are the main limitation for farming. The unit is also well suited to urban development if flooding is controlled. It is suited to development of wildlife habitat.

### **4. Torriorthents-Cryoborolls-Rock outcrop**

*Very steep, shallow to very deep, well drained soils, and Rock outcrop; on sides of mountains and canyons*

This map unit is in the Willow Creek and Tex Creek drainageways east of the Snake River flood plain. Elevation is 4,700 to 8,000 feet. The average annual precipitation is 8 to 18 inches, the average annual air temperature is 41 to 43 degrees F, and the frost-free period is 50 to 80 days.

This unit makes up about 11 percent of the survey area. It is about 45 percent Torriorthents, 35 percent Cryoborolls, and 15 percent Rock outcrop. The remaining 5 percent is soils of minor extent.

Torriorthents are on the south- and west-facing sides of canyons and mountains (fig. 3). These soils are shallow to very deep, dry, warm, light-colored loams to stony loams. Cryoborolls are on the north- and east-facing sides of canyons and mountains. These soils are shallow to very deep, moist, cold, dark-colored silt loams to stony clays. Rock outcrop is exposed rhyolite or basalt bedrock.

Of minor extent in this unit are Potell, Ririe, Rin, and Dranyon soils, Aquic Cryoborolls, and Typic Cryaquolls. Potell, Ririe, and Rin soils are silty, and Dranyon soils are loamy. Aquic Cryoborolls and Typic Cryaquolls are somewhat poorly drained or poorly drained.

This unit is used mainly as rangeland and for wildlife habitat.

This unit is limited for farming by very steep slopes and a stony surface. The main limitations for recreational homesite development and for urban uses are the hazard of erosion and very steep slopes. This unit is suited to the development of wildlife habitat.

### **5. Ride-Potell**

*Gently sloping to steep, very deep, well drained soils; on loess foothills*

This map unit is east of the Snake River flood plain and west of the Caribou Range. Elevation is 4,600 to 6,200 feet. The average annual precipitation is about 11 inches, the average annual air temperature is 43 degrees F, and the frost-free period is about 90 days.

This unit makes up about 22 percent of the survey area. It is about 70 percent Ririe soils, 15 percent Potell soils, 5 percent Araveton soils, and 5 percent Rock outcrop. The remaining 5 percent is soils of minor extent.

Ririe and Potell soils are silt loam. Araveton soils have a surface layer of extremely stony loam and a subsoil and substratum of stony loam. Rock outcrop is exposed rhyolite and basalt bedrock.

Of minor extent in this unit are Tetonia, Lanark, Rin, and Maim soils, Aquic Cryoborolls, and Typic Cryaquolls. Maim soils have bedrock at a depth of 20 to 40 inches. Tetonia, Lanark, and Rin soils, Aquic Cryoborolls, and



Figure 3.-View of Willow Creek canyon. Torriorthents and Rock outcrop in foreground, Aquic Cryoborolls in middle, and Lanark and Robin soils in background.

Typic Cryaquolls are colder in summer than the rest of the unit.

This unit is used mainly for winter wheat and spring barley. Some small areas are used as rangeland and for sprinkler-irrigated small grain, potatoes, and alfalfa.

In most years this unit is well suited to winter wheat and spring barley. Crop production is reduced if precipitation is low or the air temperature is below normal during the growing season. This unit is suited to the development of wildlife habitat. Steepness of slope and a hazard of soil erosion are the main limitations for homesite and urban development.

## 6. Dranyon-Paulson-Rock outcrop

*Sloping to very steep, deep and very deep, well drained soils, and Rock outcrop; on mountainsides*

This map unit is on the highest elevations in the southeastern part of the survey area, near the Caribou Nation-

al Forest. Elevation is 6,000 to 8,000 feet. The average annual precipitation is about 20 inches, the average annual air temperature is 41 degrees, and the frost-free period is about 50 days.

This unit makes up about 10 percent of the survey area. It is about 35 percent Dranyon soils, 25 percent Paulson soils, 15 percent Rock outcrop, and 10 percent Nielsen soils. The remaining 15 percent is soils of minor extent.

The Dranyon soils are deep. They have a surface layer of extremely stony silt loam and a subsoil of stony loam and stony Clay loam. Sandstone and shale are at a depth of 45 inches. Paulson soils are very deep. They have a surface layer of silt loam and a subsoil and substratum of silty clay and silty clay loam. Rock outcrop is exposed sandstone and shale bedrock. Nielsen soils are shallow. They have a surface layer of extremely



flaggy loam and a subsoil of extremely flaggy clay loam and extremely flaggy sandy clay loam. Sandstone is at a depth of 18 inches.

Of minor extent in this unit are Robin, Judkins, Tetonia, and Rin soils, Aquic Cryoborolls, and Typic Cryaquolls. Robin, Tetonia, and Rin soils formed in loess. Judkins soils have bedrock at a depth of 20 to 40 inches. Aquic Cryoborolls and Typic Cryaquolls formed in alluvium and have a high water table in spring.

This unit is used mainly for grazable woodland, as rangeland, and for wildlife habitat. Some areas are used for spring barley. Some cultivated crops are limited by the short growing season.

This unit is suited to range management practices such as planned grazing, brush management, reseeding, water development, fencing to control grazing, and proper grazing use.

This unit is suited to the development of wildlife habitat. Steepness of slope, shallow depth, and stones limit the use of the unit for homesite development.

## **7. Tetonia-Rin-Ride**

*Nearly level to very steep, very deep, well drained soils; on loess foothills and mountainsides*

This map unit is in the northeastern part of the survey area, on Pine Bench and in Swan Valley. Elevation is 5,200 to 7,000 feet. The average annual precipitation is 15 inches, the average annual air temperature is 42 degrees F, and the frost-free period is about 70 days.

This unit makes up about 8 percent of the survey area. It is about 50 percent Tetonia soils, 25 percent Rin soils, 15 percent Ririe soils, and 5 percent Rock outcrop. The remaining 5 percent is soils of minor extent.

Tetonia, Rin, and Ririe soils are silt loams. Rin soils are noncalcareous, and Ririe soils have a mean summer temperature of more than 59 degrees.

Of minor extent in this unit are Lanark, Robin, and Paulson soils. Lanark and Robin soils have a subsoil of silty clay loam. Paulson soils have a subsoil of silty clay.

This unit is used mainly for winter wheat and spring barley. Some small areas are used for grass pasture, alfalfa, and potatoes.

In most years this unit is well suited to winter wheat and spring barley. Crop production is reduced if precipitation is low or the air temperature is below normal during the growing season. Some cultivated crops are limited by the cold climate. A suitable cropping system for dryland farming is one that includes alternate years of grain and fallow. This unit is suited to the development of wildlife habitat. Steepness of slope and a hazard of soil erosion limit homesite development.

## **8. Hobacker-Badgerton Variant-Typic Cryaquolls**

*Nearly level to moderately steep, very deep, well drained and poorly drained soils; on flood plains*

This map unit is on the Snake River flood plain, mainly in Swan Valley. Elevation is 5,500 to 7,500 feet. The average annual precipitation is 18 inches, the average annual air temperature is 41 degrees F, and the frost-free period is about 60 days.

This unit makes up about 2 percent of the survey area. It is about 50 percent Hobacker soils, 25 percent Badgerton Variant soils, and 20 percent Typic Cryaquolls. The remaining 5 percent is soils of minor extent.

Hobacker soils are well drained. They have a surface layer of gravelly loam, very gravelly loam, and extremely gravelly sandy loam. Extremely gravelly loamy sand is at a depth of 30 inches. Badgerton Variant soils are well drained. They have a surface layer of sandy loam and underlying material of loamy sand. Very gravelly coarse sand is at a depth of 32 inches. Typic Cryaquolls are silt loam, silty clay, or sandy loam. They have a water table at a depth of 12 to 24 inches during the growing season.

Of minor extent in this unit are somewhat poorly drained Aquic Cryoborolls and well drained Lanark soils.

This unit is used mainly for pasture. Some areas are used for barley and alfalfa.

Crops on this unit are limited by the short growing season. The unit is suited to the development of wildlife habitat. The main limitations for recreational homesite development and urban uses are potential frost action and the high water table. Drainage and proper design of foundations help to overcome these limitations.

## **Broad land use considerations**

Bonneville County Area is a diversified agricultural area used for irrigated and nonirrigated cropland and as rangeland. The major trend in land use is to convert nonirrigated cropland and rangeland to irrigated cropland. There is 169,000 acres of irrigated land in the area. Sprinkler irrigation is used on 88,000 acres. The potential for additional development of irrigated cropland depends on the availability of ground water and surface water and the availability of electricity to run the pumps.

Map unit 2 is irrigated mainly by sprinklers. If developed for cropland, areas of this unit now in rangeland would have only fair potential for sprinkler irrigation because of the high percentage of Rock outcrop.

In adjoining unit 3, use of sprinkler irrigation is limited by the cost of electricity. Most farms are flood irrigated at present. Alfalfa for hay is grown on the soils that have a gravelly surface layer.

Unit 5 is mainly a large area of nonirrigated cropland. Sprinkler irrigation is used in some small areas. Additional development of irrigated cropland in this unit depends on the availability of ground water or surface water. The new Ririe Dam may provide water for this use.

The remaining upland units have poor potential for irrigation. The cold climate and short growing season limit the use of these units for most cultivated crops. Unit

1 has very poor potential for crops because of excessive amounts of basalt lava on the surface.

Crops are grown in most areas suitable for nonirrigated cropland. The largest areas of nonirrigated cropland are in units 5 and 7, and small areas are in unit 6. The potential for additional nonirrigated cropland on unit 6 is poor because it is at the higher elevations, which tends to shorten the growing season.

Scattered, small areas of deep soils on steep north- and east-facing slopes are limited for use as nonirrigated cropland because of the high hazard of erosion and the short growing season. These areas are suitable for use as rangeland.

Units 4, 6, 8, and small areas of unit 7 are well suited to grazing by cattle and sheep. Unit 2, in the western part of the area, also is well suited to grazing. Other scattered areas, mainly of the steeper and shallower soils, are used as rangeland. Unit 1 has very poor potential for nonirrigated crops or for grazing because of excessively rocky areas.

Most of the soils in the survey area are well suited to grazing. Severely eroded nonirrigated cropland can be seeded to grass and used for grazing. Proper range management practices help to maintain and improve the condition of the rangeland.

Areas of units 2 and 3 are suited to urban development. Unit 8 has good potential for urban development, but it is limited by a high water table and the hazard of flooding in spring in the small areas of Typic Cryaquolls. Units 4, 5, 6, and 7 have poor potential for urban development because of inaccessibility in winter, steepness of slope, and the instability of the soils.

Wildlife habitat is an important use in small, isolated areas of the survey area. Most of the nonirrigated cropland on units 2, 5, and 7 has fair to good potential for openland wildlife habitat. The irrigated cropland of the survey area has fair potential for upland wildlife habitat. Unit 1 is not suited to wildlife habitat.

Rangeland on units 4, 6, and 8 has fair to good potential for wildlife habitat. These soils provide adequate cover and food for upland game animals.

Most of the soils in the survey area are poorly suited to windbreaks. Units 2 and 3 are best suited because of the availability of water for irrigation. Because of the low average annual precipitation, additional water is needed when planting windbreaks.

## Soil maps for detailed planning

The map units on the detailed soil maps at the back of this survey represent the soils in the survey area. The map unit descriptions in this section, along with the soil maps, can be used to determine the suitability and potential of a soil for specific uses. They also can be used to plan the management needed for those uses. More

information on each map unit, or soil, is given under "Use and management of the soils."

Each map unit on the detailed soil maps represents an area on the landscape and consists of one or more soils for which the unit is named.

A symbol identifying the soil precedes the map unit name in the soil descriptions. Each description includes general facts about the soil, a brief description of the soil profile, and a listing of the principal hazards and limitations to be considered in planning management.

Soils that have profiles that are almost alike make up a soil series. Except for differences in texture of the surface layer or of the underlying material, all the soils of a series have major horizons that are similar in composition, thickness, and arrangement.

Soils of one series can differ in texture of the surface layer or of the underlying material. They also can differ in slope, stoniness, salinity, wetness, degree of erosion, and other characteristics that affect their use. On the basis of such differences, a soil series is divided into soil phases. Most of the areas shown on the detailed soil maps are phases of soil series. The name of a soil phase commonly indicates a feature that affects use or management. For example, Pancheri silt loam, 0 to 2 percent slopes, is one of several phases in the Pancheri series.

Some map units are made up of two or more major soils. These map units are called soil complexes.

A soil complex consists of two or more soils in such an intricate pattern or in such small areas that they cannot be shown separately on the soil maps. The pattern and proportion of the soils are somewhat similar in all areas. Paulson-Neilsen complex, 5 to 35 percent slopes, is an example.

Most map units include small scattered areas of soils other than those for which the map unit is named. Some of these included soils have properties that differ substantially from those of the major soil or soils. Such differences could significantly affect use and management of the soils in the map unit. The included soils are identified in each map unit description. Some small areas of strongly contrasting soils are identified by a special symbol on the soil maps.

This survey includes miscellaneous areas. Such areas have little or no soil material and support little or no vegetation. Lava flows is an example. Miscellaneous areas are shown on the soil maps. Some that are too small to be shown are identified by a special symbol on the soil maps.

Table 4 gives the acreage and proportionate extent of each map unit. Other tables (see "Summary of tables") give properties of the soils and the limitations, capabilities, and potentials for many uses. The Glossary defines many of the terms used in describing the soils.

## Soil descriptions

**1-Ammon silt loam, 0 to 2 percent slopes.** This very deep, well drained soil is on alluvial fans. It formed in alluvium derived dominantly from loess. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is grayish brown and brown, mildly alkaline and moderately alkaline silt loam about 15 inches thick. The underlying material to a depth of 60 inches or more is pale brown and very pale brown, moderately alkaline silt loam.

Included with this soil in mapping are small areas of Bock loam, Paul silty clay loam, Potell silt loam, and a soil that is similar to this Ammon soil but has sand and gravel at a depth of 40 to 60 inches.

Permeability of this Ammon soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight. This soil is subject to rare periods of flooding.

Most areas of this soil are used for irrigated crops. Some small areas are used for wildlife habitat. Expansion of the city of Idaho Falls has resulted in some urban development on this soil.

This soil is well suited to irrigated crops such as potatoes, small grain, sugar beets, and alfalfa. Yields are limited by the cool climate.

A suitable cropping system is one that includes 3 to 4 years of alfalfa, 2 years of potatoes or sugar beets, and 1 to 2 years of grain. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method used generally is governed by the crop. Proper irrigation water management is needed to prevent ponding or erosion.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are bluegrass, smooth brome, and orchardgrass. Few areas of this soil have native plant cover.

Crops and brushy areas of this soil provide limited food and cover for pheasant, Hungarian partridge, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate plant cover limits the wildlife population. Wildlife habitat is improved by managing crop residue and by using a suitable cropping system. Planting shrubs and windbreaks provides needed cover and food for upland game birds.

The main limitation for recreational development is the tendency of the surface to become dusty when dry, the

main limitation for septic tank absorption fields is the moderate permeability, and the main limitation for urban development is the hazard of rare flooding.

This soil is in capability subclass IIc, irrigated.

**2-Ammon silt loam, 2 to 4 percent slopes.** This very deep, well drained soil is on foothills. It formed in alluvium derived dominantly from loess. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is grayish brown and brown, mildly alkaline and moderately alkaline silt loam about 15 inches thick. The underlying material to a depth of 60 inches or more is pale brown and very pale brown, moderately alkaline silt loam.

Included with this soil in mapping are small areas of Paesl silty clay loam, Paul silty clay loam, Potell silt loam that has slopes of 0 to 4 percent, and a soil that is similar to this Ammon soil but has sand and gravel at a depth of 40 to 60 inches.

Permeability of this Ammon soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight or moderate. This soil is subject to rare periods of flooding.

Most areas of this soil are used for irrigated crops. Some small areas are used for wildlife habitat. Expansion of the city of Idaho Falls has resulted in some urban development on this soil.

This soil is well suited to irrigated crops such as potatoes, small grain, sugar beets, and alfalfa. Yields are limited by the cool climate.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method used generally is governed by the crop. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope. Proper management of irrigation water is needed to prevent puddling and erosion. Piping, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion.

A suitable cropping system is one that includes 3 to 4 years of alfalfa, 2 years of potatoes or sugar beets, and 1 to 2 years of grain. Tillage should be kept to a minimum, and crop residue should be returned to the soil.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are bluegrasses, brome, and orchardgrass. Few areas of this soil have native plant cover.

Crops and brushy areas of this soil provide food and cover for pheasant, Hungarian partridge, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of ade-

quate cover limits the wildlife population. Wildlife habitat is improved by managing crop residue and by using a suitable cropping system. Planting shrubs and windbreaks provides cover and food for upland game birds.

The main limitation for recreational development is the tendency of the soil to become dusty when dry, the main limitation for septic tank absorption fields is the moderate permeability, and the main limitation for urban development is the hazard of rare flooding.

This soil is in capability subclass IIe, irrigated.

**3-Aquic Cryoborolls-Typic Cryaquolls complex, flooded.** This complex consists of nearly level to gently sloping soils along the Willow Creek and upper South Fork of the Snake River. Elevation is 5,800 to 7,500 feet. The average annual precipitation is about 16 inches, the average annual air temperature is about 41 degrees F, and the frost-free period is about 60 days.

This complex is about 60 percent Aquic Cryoborolls and 40 percent Typic Cryaquolls.

Aquic Cryoborolls are very deep and somewhat poorly drained. They formed mainly in alluvium on flood plains. The surface layer is dark colored silt loam to silty clay about 12 inches thick. The underlying material, to a depth of 40 inches or more, is lighter colored sandy loam to silty clay. Depth to sand and gravel and content of rock fragments varies throughout the profile.

Permeability of Aquic Cryoborolls is slow to rapid. Available water capacity is low to high. Effective rooting depth is 60 inches. Runoff is slow, and the hazard of erosion is slight. These soils have a seasonal high water table, and they are flooded in spring.

Typic Cryaquolls are very deep, poorly drained soils underlain by sand and gravel. They formed in alluvium on flood plains. The surface layer is dark colored silt loam to silty clay about 14 inches thick. The underlying material, to a depth of 40 inches or more, is lighter colored sandy loam to silty clay.

Permeability of Typic Cryaquolls is slow to rapid. Available water capacity is low to high. Effective rooting depth is 60 inches. Runoff is slow, and the hazard of erosion is slight. A seasonal high water table is at a depth of 12 to 24 inches during the growing season. The soils are subject to flooding in spring.

This complex is used mainly as rangeland and for wildlife habitat.

The potential native plant community on this complex is mainly sedges, rushes, willows, and forbs. When the range deteriorates, the proportion of desirable forbs and grasses decreases and the proportion of unpalatable forbs and shrubs increases. Less desirable weeds and annual plants increase as the range condition further deteriorates.

This complex is best suited to livestock grazing in summer and early in fall. Deferred-rotation grazing and other suitable grazing management practices are needed to maintain or improve the condition of the range. The

soils in this complex are subject to overgrazing because they are along the water sources for the surrounding grazing land.

This complex provides habitat for mule deer, elk, moose, brown bear, blue grouse, sage grouse, and ducks. Small mammals and songbirds are common. Mallard is the principal game bird. Proper range management practices help to maintain the wildlife habitat.

The main limitations for homesite and recreational development are the hazard of seasonal flooding and the seasonal high water table.

This complex is in capability subclass VIw.

**4-Araveton extremely stony loam, 4 to 30 percent slopes.** This very deep, well drained soil is on south-facing slopes of foothills east of the city of Idaho Falls. It formed in loess over weathered rhyolite or basalt. Elevation is 4,700 to 6,000 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 95 days.

Typically, the upper part of the surface layer is dark grayish brown, mildly alkaline extremely stony loam about 7 inches thick. The lower part is grayish brown, mildly alkaline stony loam about 5 inches thick. The subsoil is brown and pale brown, moderately alkaline stony loam about 15 inches thick. The substratum to a depth of 60 inches or more is pale brown and very pale brown, moderately alkaline stony loam.

Included with this soil in mapping are small areas of a Ririe silt loam that has slopes of 4 to 20 percent, Tetonia silt loam, and Rock outcrop. The Tetonia soils and Rock outcrop have slopes of 12 to 30 percent.

Permeability of this Araveton soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of erosion is very high.

Most areas of this soil are used as rangeland and for wildlife habitat and recreation.

The potential plant community is mainly bluebunch wheatgrass, slender wheatgrass, big sagebrush, threetip sagebrush, arrowleaf balsamroot, and antelope bitterbrush. If the range condition deteriorates, the proportion of rabbitbrush and sagebrush increases. Brush management improves areas that are producing more big sagebrush and rabbitbrush than were present in the potential plant community.

Brushy areas of this soil provide food and cover for Hungarian partridge, mule deer, rabbits, and mourning dove.

The main limitations for homesite and recreational development are steepness of slope and stones.

This soil is in capability subclass VII, nonirrigated.

**5-Badgerton Variant sandy loam.** This very deep, well drained soil is on river terraces and alluvial fans. It formed in mixed alluvium. Slope is 0 to 4 percent. Eleva-

tion is 5,500 to 6,700 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 41 degrees F, and the frost-free period is about 65 days.

Typically, the surface layer is dark grayish brown, mildly alkaline sandy loam about 20 inches thick. The underlying material is grayish brown, mildly alkaline loamy sand about 12 inches thick over very gravelly coarse sand.

Included with this soil in mapping are small areas of Hobacker gravelly loam, Aquic Cryoborolls, and Typic Cryaquolls.

Permeability of this Badgerton soil is very rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used as rangeland and for wildlife habitat. Some small areas are used for irrigated barley, oats, and pasture.

This soil is suited to irrigated crops. Yields are limited by the cold climate.

A suitable cropping system is one that includes 3 to 4 years of alfalfa and 1 to 2 years of barley. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method used generally is governed by the crop. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope. Proper irrigation water management is needed to prevent ponding and erosion.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are intermediate wheatgrass, brome grass, and bluegrass.

If this soil is used as rangeland, the potential native plant community is mainly mountain big sagebrush, bitterbrush, bluebunch wheatgrass, and slender wheatgrasses. If the range condition deteriorates, the proportion of rabbitbrush, sagebrush, and annual forbs increases. Brush management and range seeding improve production on this soil. Wheatgrasses are suitable for seeding.

Crops and brushy areas of this soil provide food and cover for rabbits, skunks, and badger. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds.

The main limitation for recreational homesite development is the hazard of pollution of the ground water by effluent from septic tanks. The hazard of rare flooding on the included soils also limits homesite development.

This soil is in capability subclasses I<sub>Ve</sub>, irrigated, and I<sub>Vs</sub>, nonirrigated.

**6-Bannock loam.** This very deep, well drained soil is on flood plains along the Snake River. The soil formed in mixed alluvium. Slope is 0 to 2 percent. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is grayish brown, mildly alkaline and moderately alkaline loam about 4 inches thick. The subsoil is light brownish gray, moderately alkaline silt loam about 6 inches thick. The upper part of the substratum is light brownish gray, moderately alkaline gravelly loam about 10 inches thick. The lower part to a depth of 60 inches or more is extremely gravelly coarse sand.

Included with this soil in mapping are small areas of Bock loam, Harston fine sandy loam, Packham gravelly loam, Paesl silty clay loam, and a soil that is similar to this Bannock soil but has a gravelly or cobbly surface layer.

Permeability of this Bannock soil is moderate in the upper part and very rapid in the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used for irrigated crops. Some small areas are used for wildlife habitat. Expansion of the city of Idaho Falls has resulted in increased urban development on this soil.

This soil is well suited to irrigated crops such as potatoes, sugar beets, wheat, barley, and alfalfa. Yields are limited by the cool climate. Depth to underlying sand and gravel limits heavy land leveling and reduces the available water capacity.

A suitable cropping system is one that includes 3 to 4 years of alfalfa, 2 years of potatoes or sugar beets, and 1 to 2 years of grain. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method used generally is governed by the crop. Proper irrigation water management is needed to prevent overirrigation or erosion.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Smooth brome grass and orchardgrass are suitable for grazing. Few areas of this soil have native plant cover.

Crops and brushy areas of this soil provide limited food and cover for pheasants, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate plant cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and by using a suitable cropping system.

The main limitations for roads and streets are low soil strength and potential frost action. The main limitation for septic tank absorption fields is the hazard of pollution of ground water by effluent.

This soil is in capability subclass IIs, irrigated.

**7-Bock loam.** This very deep, well drained soil is on flood plains along the Snake River. The soil formed in mixed alluvium. Slope is 0 to 2 percent. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the upper part of the surface layer is grayish brown, mildly alkaline loam about 4 inches thick. The lower part is grayish brown, mildly alkaline fine sandy loam about 6 inches thick. The subsoil is pale brown, mildly alkaline fine sandy loam about 14 inches thick. The upper part of the substratum is white and light gray, mildly alkaline fine sandy loam about 21 inches thick. The lower part to a depth of 60 inches or more is very gravelly loamy sand.

Included with this soil in mapping are small areas of Ammon silt loam and Bannock loam.

Permeability of this Bock soil is moderate in the upper part and very rapid in the lower part. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used for irrigated crops. Some small areas are used for wildlife habitat. Expansion of the city of Idaho Falls has resulted in some urban, development on this soil.

This soil is well suited to irrigated crops such as potatoes, sugar beets, wheat, barley, and alfalfa. Yields are limited by the cool climate.

A suitable cropping system is one that includes 3 to 4 years of alfalfa, 2 years of potatoes or sugar beets, and 1 to 2 years of grain. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method used generally is governed by the crop. Proper irrigation water management is needed to prevent overirrigation and erosion.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are brome grass and orchardgrass. Few areas of this soil have native plant cover.

Crops and the brushy areas of the soil provide food and cover for pheasant, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife

habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for recreational development is the tendency of the surface to become, dusty when dry, the main limitations for roads and streets are potential frost action and low soil strength, and the main limitations for septic tank absorption fields are the moderate permeability and the possible pollution of ground water by effluent.

This soil is in capability subclass IIc, irrigated.

### **8-Cryoborolls-Rock outcrop complex, very steep.**

This map unit is on north- and east-facing sides of mountains and canyons in the southeastern part of the survey area. Elevation is 5,800 to 8,000 feet. The average annual precipitation is about 16 inches, the average annual air temperature is about 41 degrees F, and the frost-free period is about 60 days.

This complex is about 45 percent Cryoborolls and 30 percent Rock outcrop.

Included in this complex is 25 percent Paulson silt loam, Nielsen extremely flaggy loam, and Dranyon extremely stony silt loam.

Cryoborolls are shallow to very deep and well drained. They formed mainly in residuum derived from shale, sandstone, or volcanic rock. Slope is 35 to 65 percent. The surface layer is dark colored silt loam to stony clay about 12 inches thick. The underlying material is lighter colored silt loam to stony clay about 8 to 48 inches thick. The profile is 0 to 85 percent rock fragments. Reaction is slightly acid to mildly alkaline.

Permeability of Cryoborolls is slow to rapid. Available water capacity is low to high. Effective rooting depth generally is 20 to 60 inches. Runoff is very rapid, and the hazard of erosion is very high.

Rock outcrop generally is exposed areas of sandstone or shale that occur in a scattered, random pattern. Small areas of exposed limestone, rhyolite, and basalt are also in this unit.

Most areas of this complex are used as rangeland and for wildlife habitat.

The potential plant community on this complex is mainly quaking aspen, sagebrush, and bluegrasses. When the range deteriorates, the proportion of bluegrasses decreases and the proportion of unpalatable forbs and shrubs increases. Less desirable weeds and annual plants increase as the condition of the range further deteriorates.

This complex is best suited to livestock grazing in spring and fall. Deferred-rotation grazing and other suitable grazing management practices are needed to maintain or improve the condition of the range.

This complex produces a limited amount of forage. Steepness of slope and the instability of the soils make the area difficult to manage.

This complex provides habitat for blue grouse, sage grouse, Hungarian partridge, mule deer, elk, moose, and

brown bear. Small mammals and songbirds are common. Blue grouse is the principal game bird.

The main limitations for homesite and recreational development are steepness of slope; Rock outcrop, stones, depth to rock, and the instability of the soils.

This complex is in capability subclass Vlle.

**9-Dranyon extremely stony silt loam, 4 to 45 percent slopes.** This deep, well drained soil is on north-facing mountainsides and ridges. It formed in material weathered from fine grained sandstone. Elevation is 6,000 to 8,000 feet. The average annual precipitation is about 20 inches, the average annual air temperature is about 41 degrees F, and the frost-free period is about 55 days.

Typically, the surface layer is dark grayish brown, slightly acid extremely stony silt loam about 4 inches thick. The upper part of the subsoil is dark grayish brown, neutral stony loam about 16 inches thick. The lower part is brown and light yellowish brown, neutral stony clay loam about 25 inches thick. Interbedded sandstone and shale are at a depth of 45 inches.

Included with this soil in mapping are small areas of Robin silt loam that has slopes of 4 to 30 percent, Paulson silt loam that has slopes of 12 to 30 percent, and a soil that is similar to this Dranyon soil but has bedrock at a depth of less than 40 inches or has a thin organic layer on the surface. Also included are areas of a soil that is similar to this Dranyon soil but has a subsurface layer.

Permeability of this Dranyon soil is moderately slow. Available water capacity is high. Effective rooting depth is 40 inches or more. Runoff is very rapid, and the hazard of erosion is very high.

This soil is used for livestock grazing, wildlife habitat, and recreation.

Quaking aspen and a few conifers that grow on this soil are a source of firewood for Idaho Falls residents. The site index for aspen is 68. A full stand at 70 years of age can produce 1,750 cubic feet of cordwood or a total volume of 2,750 cubic feet per acre.

The native understory plant community is mainly young aspen, snowberry, blue wildrye, Kentucky bluegrass, and elk sedge. The average annual production of air-dry forage that can be used for livestock grazing and wildlife habitat is about 1,700 pounds per acre.

This soil is suited to woodland wildlife habitat. Brushy areas provide food and cover for mule deer, moose, elk, ruffed grouse, songbirds, and various birds of prey.

The main limitations for recreational homesite development are large stones and steepness of slope.

This unit is in capability subclass Vlls, nonirrigated.

**10-Harston fine sandy loam.** This very deep, well drained soil is on flood plains along the Snake River. It formed in mixed alluvium. Slope is 0 to 2 percent. Elevation is 4,600 to 5,000 feet. The average annual precipita-

tion is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is light brownish gray, mildly alkaline fine sandy loam about 10 inches thick. The upper, part of the underlying material is pale brown and light gray, moderately alkaline fine sandy loam about 15 inches thick. The lower part to a depth of 60 inches or more is very gravelly coarse sand.

Included with this soil in mapping are small areas of Bannock loam; Heiseton fine sandy loam, drained; Packham gravelly loam; and Xeric Torrifluvents.

Permeability of this Harston soil is moderately rapid in the upper part and very rapid in the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used for irrigated crops. Some small areas are used for wildlife habitat. Expansion of the city of Idaho Falls has resulted in some urban development on this soil.

This soil is well suited to irrigated crops such as potatoes, wheat, barley, and alfalfa. Yields are limited by the cool climate. Depth to underlying sand and gravel limits heavy land leveling and restricts the available water capacity.

A suitable cropping system is one that includes 3 to 4 years of alfalfa, 2 years of potatoes, and 1 to 2 years of grain. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method used generally is governed by the crop. Proper irrigation water management is needed to prevent overirrigation and erosion.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are brome grass, orchardgrass and crested wheatgrass. Few areas of this soil have native plant cover.

Crops and the brushy areas of this soil provide food and cover for pheasants, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife, population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for urban development is the hazard of rare flooding, the main limitation for roads and streets is potential frost action, and the main limitations for septic tank absorption fields are the hazard of rare flooding and the hazard of pollution of ground water by effluent.

This soil is in capability subclass Ills, irrigated.

**11-Heiseton fine sandy loam, drained.** This very deep soil is on flood plains along the Snake River. Drainage has been altered by the interception of water sources. The soil formed in mixed alluvium. Slope is 0 to 2 percent. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the upper part of the surface layer is grayish brown, mildly alkaline fine sandy loam about 8 inches thick. The lower part is pale brown, mildly alkaline fine sandy loam about 6 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray, pale brown, and light gray, mildly alkaline fine sandy loam and loam.

Included with this soil in mapping are small areas of Harston fine sandy loam and Xeric Torrifluvents.

Permeability of this Heiseton soil is moderately rapid. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used for irrigated crops. Some small areas are used for wildlife habitat. Expansion of the city of Idaho Falls has resulted in some urban development on this soil.

This soil is well suited to irrigated crops such as potatoes, wheat, barley, and alfalfa. Yields are limited by the cool climate.

A suitable cropping system is one that includes 3 to 4 years of alfalfa, 2 years of potatoes, and 1 to 2 years of grain. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method used generally is governed by the crop. Proper irrigation water management is needed to prevent overirrigation and erosion.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are brome grass and crested wheatgrass. Few areas of this soil have native plant cover.

Crops and the brushy areas of this soil provide food and cover for pheasant, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitations for roads and streets are frost action and low soil strength, and the main limitation for septic tank absorption fields is the hazard of pollution of ground water by effluent.

This soil is in capability subclass IIc, irrigated.

### **12-Hobacker gravelly loam, 0 to 4 percent slopes.**

This very deep, well drained soil is on flood plains. It formed in alluvium. Elevation is 6,000 to 7,000 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 41 degrees F, and the frost-free period is about 65 days.

Typically, the upper part of the surface layer is dark grayish brown, mildly alkaline gravelly loam about 4 inches thick. The lower part is grayish brown and brown, mildly alkaline very gravelly loam and extremely gravelly sandy loam about 18 inches thick. The underlying material to a depth of 60 inches or more is pale brown, moderately alkaline extremely gravelly loamy sand.

Included with this soil in mapping are small areas of Badgerton Variant sandy loam, Aquic Cryoborolls, Typic Cryaquolls, and a soil that is similar to this Hobacker soil but has less than 35 percent rock fragments in the lower part.

Permeability of this Hobacker soil is moderate in the upper part and very rapid in the lower part. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used for irrigated crops. Some small areas are used as rangeland.

This soil is suited to irrigated crops such as alfalfa, barley, and pasture. Yields are limited by the cold climate.

The potential native plant community is mainly mountain big sagebrush, bitterbrush, bluebunch wheatgrass, and Columbia needlegrass. If the range condition deteriorates, the proportion of rabbitbrush, sagebrush, and annual forbs increases. Range seeding and brush management improve production on this soil. Seeding is difficult because of the gravelly or cobbly surface layer. Siberian wheatgrass, crested wheatgrass, and pubescent wheatgrass are suitable for seeding.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are wheatgrasses and bluegrasses. Few areas of this soil have native plant cover.

A suitable cropping system is one that includes 3 to 4 years of alfalfa and 1 to 2 years of barley. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method used generally is governed by the crop. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope. Proper irrigation water management is needed to prevent overirrigation or erosion.

Crops and the brushy areas of the soil provide food and cover for mourning dove, rabbits, skunks, and badger. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover



limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for septic tank absorption fields is the hazard of pollution of ground water by effluent, and the main limitations for recreational development are gravel and stones.

This soil is in capability subclasses IVs, irrigated, and IVs, nonirrigated.

### **13-Hobacker gravelly loam, 4 to 10 percent slopes.**

This very deep, well drained soil is on fans along the south fork of the Snake River (fig. 4). The soil formed in alluvium. Elevation is 6,000 to 7,000 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 41 degrees F, and the frost-free period is about 65 days.

Typically, the upper part of the surface layer is dark grayish brown, mildly alkaline gravelly loam about 4 inches thick. The lower part is light brownish gray and brown, mildly alkaline very gravelly loam and extremely gravelly sandy loam about 18 inches thick. The underlying material to a depth of 60 inches or more is pale brown, moderately alkaline extremely gravelly loamy sand.

Included with this soil in mapping are small areas of Badgerton Variant sandy loam, Aquic Cryoborolls, and Typic Cryaquolls that have slopes of 0 to 4 percent. Also included is a soil that is similar to this Hobacker soil but has less than 35 percent rock fragments in the lower part.

Permeability of this Hobacker soil is moderate in the upper part and very rapid in the lower part. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight.

These soils are used mainly as rangeland and for irrigated pasture. Some areas are used for urban and recreational development. .

The potential native plant community is mainly mountain big sagebrush, bitterbrush, bluebunch wheatgrass, and Columbia needlegrass. Range seeding and brush management improve production on this soil. Seeding is difficult because of the gravelly or cobbly surface layer. Siberian wheatgrass, crested wheatgrass, and pubescent wheatgrass are suitable for seeding.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum



Figure 4. -Area of Hobacker gravelly loam in Swan Valley. These soils are mainly used for pasture. Some areas are used for irrigated winter wheat and alfalfa.

height. Plants suitable for grazing are wheatgrasses and bluegrasses.

The brushy areas of this soil provide food and cover for mourning dove, rabbits, skunks, and badger. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds.

The main limitation for septic tank absorption fields is the hazard of pollution of ground water by effluent, and the main limitations for recreational development are gravel and stones.

This soil is in capability subclass IVe, nonirrigated.

**14-Judkins extremely stony loam, 8 to 30 percent slopes.** This moderately deep, well drained soil is on north- and east-facing slopes south of Antelope Flats. It formed in material weathered from rhyolite, rhyolitic tuff, and latite. Elevation is 6,000 to 7,000 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 41 degrees F, and the frost-free period is about 50 days.

Typically, the surface is covered with a duff layer of needles and twigs about 2 inches thick. The surface layer is dark grayish brown, slightly acid and neutral extremely stony loam about 8 inches thick. The subsurface layer is pale brown, slightly acid extremely stony loam about 7 inches thick. The upper part of the subsoil is brown, slightly acid extremely stony clay loam about 8 inches thick. The lower part is yellowish brown, slightly acid extremely stony clay loam about 5 inches thick. Rhyolite is at a depth of 28 inches.

Included with this soil in mapping are small areas of Dranyon extremely stony silt loam that has slopes of 4 to 45 percent, Cryoborolls that have slopes of 4 to 30 percent, and Rock outcrop.

Permeability of this Judkins soil is moderate. Available water capacity is very low. Effective rooting depth is 20 to 40 inches. Runoff is medium to rapid, and the hazard of erosion is moderate to very high.

Most areas of this soil are used for woodland grazing and wildlife habitat.

The Judkins soil is moderately suited to the production of Douglas-fir. It can produce about 4,000 cubic feet, or 7,000 board feet (Scribner rule), of merchantable timber per acre from a fully stocked stand of even-aged trees 80 years old. The main limitations for producing and harvesting timber are the short growing season, steepness of slope, and low precipitation, which affect seedling mortality.

The potential native plant community is mainly Douglas-fir and an understory of big bluegrass, pine reedgrass, lupine, and snowberry. The average annual production of air-dry forage used for livestock grazing and wildlife habitat is about 500 pounds per acre.

This soil is suited to wildlife habitat. Crops and brushy areas provide food and cover for mule deer, elk, moose, blue grouse, and ruffed grouse.

The main limitations for homesite and recreational development are steepness of slope and stoniness.

This soil is in capability subclass VIIs, nonirrigated.

**15-Lanark silt loam, 4 to 20 percent slopes.** This very deep, well drained soil is on mountainsides southeast of Bone. The soil formed in loess. Elevation is 6,000 to 7,000 feet. The average annual precipitation is about 16 inches, the average annual air temperature is about 41 degrees F, and the frost-free period is about 60 days.

Typically, the surface layer is grayish brown, mildly alkaline silt loam about 5 inches thick. The upper part of the subsoil is grayish brown, mildly alkaline silt loam about 5 inches thick. The lower part is brown, mildly alkaline silty clay loam about 15 inches thick. The substratum to a depth of 60 inches or more is pale brown and very pale brown, neutral and mildly alkaline silt loam.

Included with this soil in mapping are small areas of Robin silt loam that has slopes of 4 to 30 percent, Tetonia silt loam that has slopes of 4 to 12 percent, and Aquic Cryoborolls and Typic Cryaquolls that have slopes of 0 to 4 percent. Also included is a soil that is similar to this Lanark soil but has basalt stones and boulders on the surface and has slopes of 4 to 8 percent.

Permeability of this Lanark soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used as rangeland and for wildlife habitat and recreation. The cold climate and short growing season limit use for most cultivated crops.

The potential native plant community is mainly bluebunch wheatgrass, slender wheatgrass, mountain big sagebrush, and bitterbrush. If the range condition deteriorates, the proportion of rabbitbrush, sagebrush, and annual forbs increases. Range seeding and brush management improve production on this soil. Pubescent wheatgrass, Siberian wheatgrass, and crested wheatgrass are suitable for seeding.

This soil is suited to wildlife habitat. Crops and brushy areas provide food and cover for mule deer, elk, moose, mourning dove, sage grouse, and blue grouse.

The main limitation for homesite and recreational development is slope. The main limitation for roads is the potential frost action.

This soil is in capability subclass IVe, nonirrigated.

**16-Lanark silt loam, 20 to 45 percent slopes.** This very deep, well drained soil is on mountainsides southeast of Bone. It formed in loess. Elevation is 6,000 to 7,000 feet. The average annual precipitation is about 16 inches, the average annual air temperature is about 41 degrees F, and the frost-free period is about 60 days.

Typically, the surface layer is grayish brown, mildly alkaline silt loam about 5 inches thick. The upper part of the subsoil is grayish brown, mildly alkaline silt loam

about 5 inches thick. The lower part is brown, mildly alkaline silty clay loam about 15 inches thick. The substratum to a depth of 60 inches or more is pale brown and very pale brown, neutral and mildly alkaline silt loam.

Included with this soil in mapping are small areas of Dranyon extremely stony silt loam that has slopes of 4 to 45 percent, Robin silt loam that has slopes of 4 to 30 percent, and Rock outcrop.

Permeability of this Lanark soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used as rangeland and for wildlife habitat and recreation.

The potential native plant community is mainly bluebunch wheatgrass, slender wheatgrass, big sagebrush, and bitterbrush. If the range condition deteriorates, the proportion of rabbitbrush, sagebrush, and annual forbs increases. Seeding is limited by steepness of slope. Areas with slopes of 30 percent or more should be avoided when selecting sites to be seeded. Pubescent wheatgrass, slender wheatgrass, and crested wheatgrass are suitable for seeding.

This unit is suited to wildlife habitat. Brushy areas provide food and cover for mule deer, elk, moose, mourning dove, sage grouse, and blue grouse. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides needed cover and food for upland game birds.

The main limitation for homesite and recreational development is steepness of slope. Potential frost action is a limitation for roads.

This soil is in capability subclass VIe, nonirrigated.

**17-Lava flows.** Lava flows is areas of sharp, jagged surfaces, crevices, and angular blocks of lava. Some soil material is in a few cracks and sheltered pockets. Lava flows supports very little vegetation.

This map unit is in capability class VIII.

#### **18-Malm fine sandy loam, 4 to 12 percent slopes.**

This moderately deep, well drained soil is on foot slopes of remnant volcanic cones east of the city of Idaho Falls. It formed in eolian deposits over rhyolite or basalt. Elevation is 4,600 to 5,500 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is grayish brown, mildly alkaline fine sandy loam about 7 inches thick. The subsoil is light brownish gray, moderately alkaline fine sandy loam 11 inches thick. The upper part of the substratum is light gray, moderately alkaline fine sandy loam about 6 inches thick. The lower part is light gray and very pale brown, strongly alkaline gravelly fine sandy loam and cobbly fine sandy loam about 14 inches thick. Basalt is at a depth of 38 inches.

Included with this soil in mapping are small areas of Ririe silt loam that has slopes of 4 to 12 percent, Araveton extremely stony loam that has slopes of 4 to 30 percent, and Rock outcrop.

Permeability of this Malm soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 22 to 38 inches. Runoff is rapid, and the hazard of erosion is moderate.

Most areas of this soil are used for dryland wheat, as rangeland, and for wildlife habitat. Expansion of the city of Idaho Falls has resulted in some urban development on this soil.

The potential native plant community is mainly big sagebrush, threetip sagebrush, and bluebunch wheatgrass. If the range condition deteriorates, the proportion of cheatgrass, rabbitbrush, and Canada thistle increases. Range seeding and brush management improve production on this soil. Crested wheatgrass, pubescent wheatgrass, and Siberian wheatgrass are suitable for seeding.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are bluegrass, brome grass, and wheatgrasses.

A suitable cropping system is one that includes alternate years of crops and summer fallow. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed. Tillage is difficult in some areas because of the depth to bedrock and stones on the surface. Contour farming, gradient terracing, stubble mulching, and grassed waterways on the lower slopes can be used to control erosion. Some sprinkler irrigation systems are used on this soil.

Crops and the brushy areas of this soil provide food and cover for pheasants, Hungarian partridge, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitations for urban and recreational development are slope and depth to bedrock.

This soil is in capability subclasses IVe, irrigated, and VIe, nonirrigated.

**19-Malm fine sandy loam, 12 to 20 percent slopes.** This moderately deep, well drained soil is on foot slopes of remnant volcanic cones east of the city of Idaho Falls. The soil formed in eolian deposits over basalt. Elevation is 4,600 to 5,500 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is grayish brown, mildly alkaline fine sandy loam about 7 inches thick. The sub-

soil is light brownish gray, moderately alkaline fine sandy loam 11 inches thick. The upper part of the substratum is light gray, moderately alkaline fine sandy loam 6 inches thick. The lower part is light gray and very pale brown, strongly alkaline gravelly fine sandy loam and cobbly fine sandy loam about 14 inches thick. Basalt is at a depth of 38 inches.

Included with this soil in mapping are small areas of Araveton extremely stony loam that has slopes of 4 to 30 percent, Ririe silt loam, and Rock outcrop.

Permeability of this Malm soil is moderately rapid. Available water capacity is very low. Effective rooting depth is 22 to 38 inches or more. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for dryland wheat, as rangeland, and for wildlife habitat. Expansion of the city of Idaho Falls has resulted in some urban development on this soil.

The potential native plant community is mainly big sagebrush, threetip sagebrush, and bluebunch wheatgrass. If the range condition deteriorates, the proportion of cheatgrass, rabbitbrush, and Canada thistle increases. Range seeding and brush management improve production on this soil. Crested wheatgrass, pubescent wheatgrass, and Siberian wheatgrass are suitable for seeding.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are bluegrass, brome grass, and wheatgrasses.

A suitable cropping system is one that includes alternate years of crops and summer fallow. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed. Tillage is difficult in some areas because of the depth to bedrock and stones on the surface. Contour farming, gradient terracing, stubble mulching, and grassed waterways on the lower slopes can be used to control erosion.

Crops and the brushy areas of this soil provide food and cover for pheasant, Hungarian partridge, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitations for urban and recreational development are depth to bedrock and steepness of slope.

This soil is in capability subclass VIe, nonirrigated.

**20-Packham gravelly loam.** This very deep, well drained soil is on flood plains along the Snake River. The soil formed in alluvium. Slope is 0 to 2 percent. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air

temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the upper part of the surface layer is dark brown, mildly alkaline gravelly loam about 4 inches thick. The lower part is grayish brown, mildly alkaline very gravelly loam about 4 inches thick. The subsoil is brown, mildly alkaline very gravelly loam about 7 inches thick. The upper part of the substratum is pale brown, mildly alkaline very gravelly sandy loam about 8 inches thick. The lower part to a depth of 60 inches or more is pale brown, mildly alkaline extremely gravelly loamy sand.

Included with this soil in mapping are small areas of Bannock loam, Harston fine sandy loam, and a soil that is similar to this Packham soil but has a cobbly surface layer.

Permeability of this Packham soil is moderate in the upper part and very rapid in the lower part. Available water capacity is very low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used for irrigated crops and wildlife habitat. Expansion of the city of Idaho Falls has resulted in some urban development on this soil.

This soil is suited to irrigated crops such as alfalfa and small grain. Yields are limited by the cool climate. Heavy land leveling may expose the gravelly subsoil and underlying material and reduce the available water capacity of the soil.

A suitable cropping system is one that includes 3 to 4 years of alfalfa and 1 to 2 years of grain. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method used generally is governed by the crop. Droughtiness makes irrigation of this soil difficult. Proper irrigation water management is needed to prevent overirrigation and erosion.

Suitable grazing management practices for irrigated alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are brome grass and crested wheatgrass. Few areas of this soil have native plant cover.

Crops and brushy areas of this soil provide food and cover for pheasant, Hungarian partridge, mourning dove, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for septic tank absorption fields is the hazard of pollution of ground water by effluent, the main limitation for roads and streets is potential frost action, and the main limitation for recreational development is the content of gravel in the soil.

This soil is in capability subclass IVs, irrigated.

**21-Paesi silty clay loam.** This very deep, well drained soil is on flood plains along the lower Willow Creek. The soil formed in alluvium. Slope is 0 to 2 percent. Elevation is 4,600 to 4,800 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the upper part of the surface layer is brown, mildly alkaline silty clay loam about 5 inches thick. The lower part is reddish gray, moderately alkaline silty clay loam about 5 inches thick. The subsoil is light grayish brown, moderately alkaline silty clay loam about 7 inches thick. The upper part of the substratum is light gray, moderately alkaline silty clay loam about 8 inches thick. The lower part to a depth of 60 inches or more is very gravelly loamy coarse sand.

Included with this soil in mapping are small areas of Bannock loam and Paul silty clay loam.

Permeability of this Paesi soil is moderate in the upper part and very rapid in the lower part. Available water capacity is moderate. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight. The Paesi soil is subject to rare periods of flooding when the snowfall is average or above average. The ground is frozen in many places, and a quick thaw results in excessive runoff from the dryland farms along Sand Creek.

Most areas of this soil are used for irrigated crops. Some small areas are used for wildlife habitat. Expansion of the city of Idaho Falls has resulted in some urban development on this soil.

This soil is well suited to irrigated crops such as potatoes, sugar beets, barley, wheat, and alfalfa. Heavy land leveling may expose the very gravelly subsoil and underlying material and reduce available water capacity.

A suitable cropping system is one that includes 3 to 4 years of alfalfa, 2 years of potatoes or sugar beets, and 1 or 2 years of grain. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method used generally is governed by the crop. Proper irrigation water management is needed to prevent overirrigation and erosion.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are bluegrasses, brome grass, and wheatgrasses. Few areas of this soil have native plant cover.

Crops and the brushy areas of this soil provide food and cover for pheasant, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks

provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for urban and recreational development is the hazard of flooding, the main limitations for roads and streets are potential frost action and low soil strength, and the main limitation for septic tank absorption fields is the hazard of pollution of ground water by effluent.

This soil is in capability subclass IIw, irrigated.

**22-Pancheri silt loam, 0 to 2 percent slopes.** This very deep, well drained soil is on basalt plains. It formed in loess. Elevation is 4,600 to 5,400 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is light brownish gray, moderately alkaline silt loam about 6 inches thick. The subsoil is pale brown, moderately alkaline silt loam about 4 inches thick. The substratum to a depth of 60 inches or more is light gray and very pale brown, strongly alkaline silt loam.

Included with this soil in mapping are small areas of Polatis silt loam that has slopes of 2 to 25 percent, a soil that has bedrock at a depth of less than 20 inches, and a soil in playas that is similar to this Pancheri soil but has a clay accumulation in the subsoil. Also included are small areas of a soil that is similar to this Pancheri soil but has a high concentration of carbonatic clay in the substratum.

Permeability of this Pancheri soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight.

This soil is used mainly for irrigated crops. Some areas are used for wildlife habitat and recreational development.

This soil is well suited to irrigated potatoes, sugar beets, alfalfa, and wheat. Yields are limited by the cool climate.

A suitable cropping system is one that includes 3 to 4 years of alfalfa, 2 years of potatoes or sugar beets, and 1 to 2 years of grain.

The layer of lime below the subsoil restricts the movement of water. Excessive land leveling may expose this lime layer, which tends to reduce yields because of lime-induced chlorosis.

The hazard of erosion is increased in the more sloping areas if this soil is tilled intensively. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method used generally is governed by the crop. Proper irrigation water management is needed to reduce erosion and puddling.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are orchardgrass, brome grass, and wheatgrasses. Small areas of this soil have native plant cover consisting mainly of bluebunch wheatgrass, big sagebrush, and threetip sagebrush.

Crops and brushy areas of this soil provide food and cover for pheasant, mourning dove, songbirds, various birds of prey, rabbits, and coyote. Migrating ducks and some Canadian geese feed in the harvested grainfields near the Snake River. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for urban development is low soil strength, the main limitation for septic tank absorption fields is moderate permeability, the main limitations for roads and streets are potential frost action and low soil strength, and the main limitation for recreational development is the tendency of the surface to become dusty when dry.

This soil is in capability subclasses IIc, irrigated, and VIc, nonirrigated.

**23-Pancheri silt loam, 2 to 4 percent slopes.** This very deep, well drained soil is on basalt plains. It formed in loess. Elevation is 4,600 to 5,400 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is light brownish gray, moderately alkaline silt loam about 6 inches thick. The subsoil is pale brown, moderately alkaline silt loam about 4 inches thick. The substratum to a depth of 60 inches or more is light gray and very pale brown, strongly alkaline silt loam.

Included with this soil in mapping are small areas of Polatis silt loam that has slopes of 2 to 25 percent, a soil that is similar to Polatis soils but has bedrock at a depth of less than 20 inches, and a soil in playas that is similar to this Pancheri soil but has a clay accumulation in the subsoil. Also included are small areas of a soil that is similar to this Pancheri soil but has a high concentration of carbonatic clay in the substratum.

Permeability of this Pancheri soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used for irrigated crops. Some small areas in the extreme western part of the survey area are used as rangeland and for wildlife habitat and recreational development.

This soil is well suited to irrigated crops such as potatoes, sugar beets, alfalfa, and wheat. Yields are limited by the cool climate.

A suitable cropping system is one that includes 3 to 4 years of alfalfa, 2 years of potatoes or sugar beets, and 1 to 2 years of grain.

The layer of lime below the subsoil restricts the movement of water. Excessive land leveling may expose this lime layer and reduce yields because of lime-induced chlorosis.

Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method used generally is governed by the crop. If furrow or corrugation irrigation systems are used, runs should be on the contour or across the slope. Piping, ditch lining, or drop structures should be installed in irrigation ditches to facilitate irrigation and prevent excessive ditch erosion. Proper irrigation water management is needed to prevent erosion and puddling.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are orchardgrass, brome grass, and wheatgrass.

Where this soil is used as rangeland, the potential native plant community is mainly big sagebrush, threetip sagebrush, and bluebunch wheatgrass. If range condition deteriorates, the proportion of cheatgrass, rabbitbrush, and Canada thistle increases. Range seeding and brush management improve production on this soil. Crested wheatgrass, pubescent wheatgrass, and Siberian wheatgrass are suitable for seeding.

Crops and brushy areas of this soil provide food and cover for pheasant, mourning dove, songbirds, various birds of prey, rabbits, and coyote. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for urban development is low soil strength, the main limitation for septic tank absorption fields is moderate permeability, the main limitations for roads and streets are potential frost action and low soil strength, and the main limitation for recreational development is the tendency of the surface to become dusty when dry.

This soil is in capability subclasses IIe, irrigated, and VIc, nonirrigated.

**24-Pancheri silt loam, 4 to 8 percent slopes.** This very deep, well drained soil is on basalt plains. It formed in loess. Elevation is 4,600 to 5,400 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is light brownish gray, moderately alkaline silt loam about 6 inches thick. The subsoil is pale brown, moderately alkaline silt loam about 4 inches thick. The substratum to a depth of 60 inches or more is light gray and very pale brown, strongly alkaline silt loam.

Included with this soil in mapping are small areas of Polatis silt loam that has slopes of 2 to 25 percent; a soil that has bedrock at a depth of less than 20 inches; and a soil, in playas, that is similar to this Pancheri soil but has a clay accumulation in the subsoil. Also included are small areas of a soil that is similar to this Pancheri soil but has a high concentration of carbonatic clay in the substratum.

Permeability of this Pancheri soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are used for irrigated crops. Some small areas are used as rangeland and for wildlife habitat and recreational development.

This soil is well suited to irrigated crops such as potatoes, sugar beets, alfalfa, and small grain. Yields are limited by the cool climate.

A suitable cropping system is one that includes 3 to 4 years of alfalfa, 2 years of potatoes or sugar beets, and 1 to 2 years of grain. The layer of lime below the subsoil restricts the movement of water. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed.

Sprinkler irrigation systems are suited to this soil. Proper irrigation water management is needed to prevent erosion and puddling.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are orchardgrass, brome grass, and wheatgrasses.

Where this soil is used as rangeland, the potential native plant community is mainly big sagebrush, threetip sagebrush, and bluebunch wheatgrass. If the range condition deteriorates, the proportion of cheatgrass, rabbitbrush, and Canada thistle increases. Range seeding and brush management improve production on this soil. Crested wheatgrass, pubescent wheatgrass, and Siberian wheatgrass are suitable for seeding.

Crops and the brushy areas of this soil provide food and cover for pheasant, mourning dove, songbirds, various birds of prey, rabbits, and coyote. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for urban development is low soil strength, the main limitation for septic tank absorption

fields is moderate permeability, and the main limitations for roads and streets are potential frost action and low soil strength. The tendency of the surface to become dusty when dry is the main limitation for recreational development.

This soil is in capability subclasses IIIe, irrigated, and VIe, nonirrigated.

**25-Pancheri silt loam, 8 to 15 percent slopes.** This very deep, well drained soil is on basalt plains. It formed in loess. Elevation is 4,600 to 5,400 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is light brownish gray, moderately alkaline silt loam about 6 inches thick. The subsoil is pale brown, moderately alkaline silt loam about 4 inches thick. The substratum to a depth of 60 inches or more is light gray and very pale brown, strongly alkaline silt loam.

Included with this soil in mapping are small areas of Polatis silt loam that has slopes of 2 to 25 percent and a soil that has bedrock at a depth of less than 20 inches. Also included are small areas of a soil that is similar to this Pancheri soil but has a high concentration of carbonatic clay in the substratum.

Permeability of this Pancheri soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of erosion is high.

Most areas of this soil are used for irrigated crops. Some small areas are used as rangeland and for wildlife habitat and recreational development.

This soil is well suited to irrigated crops such as potatoes, sugar beets, alfalfa, and small grain. Yields are limited by the cool climate.

A suitable cropping system is one that includes 3 to 4 years of alfalfa, 2 years of potatoes or sugar beets, and 1 to 2 years of grain.

The layer of lime below the subsoil restricts the movement of water. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed. Proper irrigation water management is needed to prevent erosion and puddling. Areas where slope is more than 10 percent are difficult to irrigate, and the hazard of erosion in these areas is very high.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are orchardgrass, smooth brome, brome grass, and wheatgrasses.

Where this soil is used as rangeland, the potential native plant community is mainly big sagebrush, threetip sagebrush, and bluebunch wheatgrass. If range condition deteriorates, the proportion of cheatgrass, rabbitbrush, and Canada thistle increases. Range seeding and brush

Management improve production on this soil. Crested wheatgrass, pubescent wheatgrass, and Siberian wheatgrass are suitable for seeding.

Crops and the brushy areas of this soil provide food and cover for pheasant, mourning dove, songbirds, various birds of prey, rabbits, and coyote. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitations for urban development are slope and low soil strength, the main limitations for septic tank absorption fields are slope and moderate permeability, and the main limitations for roads and streets are slope, low soil strength, and potential frost action. Slope and the tendency of the surface to become dusty when dry are the main limitations for recreational development.

This soil is in capability subclasses IVe, irrigated, and VIe, nonirrigated.

**26-Pancheri-Rock outcrop complex, 2 to 25 percent slopes.** This map unit is on loess-covered basalt plains. Elevation is 4,200 to 5,400 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

This complex is about 70 percent Pancheri silt loam, 4 to 25 percent slopes, and 25 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

The Pancheri soil is very deep and well drained. It formed mainly in loess. Typically, the surface layer is light brownish gray, moderately alkaline silt loam about 6 inches thick. The subsoil is pale brown, moderately alkaline silt loam about 4 inches thick. The substratum is pale brown and light gray, strongly alkaline silt loam. Basalt is at a depth of 60 inches or more.

Permeability of the Pancheri soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is slow to rapid, and the hazard of erosion is slight to high.

Rock outcrop is bare exposures of basalt protruding through the mantle of loess. Rock outcrop resists weathering and, except where soil is in cracks and depressions, supports few plants other than lichens.

This complex is used mainly as rangeland and for wildlife habitat. Some areas are used for recreational development.

The potential native plant community on this complex is mainly big sagebrush, bluebunch wheatgrass, Sandberg bluegrass, and rabbitbrush. If the range deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of unpalatable forbs and shrubs increases. Less desirable weeds and annual plants in-

crease as the range condition further deteriorates. This complex is best suited to grazing by sheep in winter and spring.

The Pancheri soil produces good forage in most years, but Rock outcrop has very limited productivity. Seeding by mechanical means is limited by Rock outcrop.

This complex provides habitat for jackrabbits, pronghorn antelope, sage grouse, coyote, songbirds, and various birds of prey. Small mammals and songbirds are common. Sage grouse is the principal game bird. Proper range management practices help to maintain the quality of wildlife habitat.

The main limitations for roads and streets are slope, potential frost action, and low soil strength. The main limitations for urban development are slope and low soil strength. Slope, dustiness, and Rock outcrop limit recreational development. Rock outcrop limits excavation and construction.

This soil is in capability subclass VIe, nonirrigated.

**27-Paul sandy loam.** This very deep, well drained soil is on the flood plain along the lower Willow Creek. It formed in alluvium. Slope is 0 to 2 Percent. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the upper part of the surface layer is reddish gray, mildly alkaline sandy loam about 12 inches thick. The lower part is reddish brown, mildly alkaline silty clay loam about 4 inches thick. The subsoil is light reddish brown, moderately alkaline silty clay loam about 31 inches thick. The substratum to a depth of 60 inches or more is pale brown, moderately alkaline silt loam.

Included with this soil in mapping are small areas of Paesl silty clay loam and Paul silty clay loam.

Permeability of this Paul soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of erosion is slight. The Paul soil is subject to rare periods of flooding when the snowfall is average or above average.

Most areas of this soil are used for irrigated crops. Some small areas are used for wildlife habitat. Expansion of Idaho Falls has resulted in some urban development on this soil.

This soil is well suited to irrigated crops such as potatoes, sugar beets, barley, wheat, and alfalfa. Yields are limited by the cool climate.

A suitable cropping system is one that includes 3 to 4 years of alfalfa, 2 years of potatoes or sugar beets, and 1 to 2 years of grain. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method used generally is governed by the crop. If furrow irrigation is used,



water should be applied at frequent intervals and runs should be short. Proper irrigation water management is needed to prevent overirrigation and erosion.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are brome-grasses and orchardgrass. Few areas of this soil have native plant cover.

Crops and the brushy areas of this soil provide food and cover for pheasant, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for urban and recreational development is the hazard of flooding. Potential frost action is a limitation for roads and streets, and moderately slow permeability is a limitation for septic tank absorption fields.

This soil is in capability subclass IIe, irrigated.

**28-Paul silty clay loam.** This very deep, well drained soil is on the flood plain along the lower Willow Creek. It formed in alluvium. Slope is 0 to 2 percent. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the upper part of the surface layer is reddish gray, mildly alkaline silty clay loam about 5 inches thick. The lower part is reddish brown, mildly alkaline silty clay loam about 8 inches thick. The subsoil is light reddish brown, moderately alkaline silty clay loam about 32 inches thick. The upper part of the substratum is pale brown, moderately alkaline silt loam about 13 inches thick. The lower part to a depth of 60 inches or more is very gravelly coarse sand.

Included with this soil in mapping are small areas of Paesl silty clay loam and Paul sandy loam.

Permeability of this Paul soil is moderately slow in the upper part and very rapid in the lower part. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is very slow, and the hazard of erosion is slight. This Paul soil is subject to rare periods of flooding when the snowfall is average or above average.

Most areas of this soil are used for irrigated crops. Some small areas are used for wildlife habitat. Expansion of the city of Idaho Falls has resulted in some urban development on this soil.

This soil is well suited to irrigated crops such as potatoes, sugar beets, barley, wheat, and alfalfa. Yields are limited by the cool climate.

A suitable cropping system is one that includes 3 to 4 years of alfalfa, 2 years of potatoes or sugar beets, and 1 to 2 years of grain. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed.

Furrow, border, corrugation, and sprinkler irrigation systems are suited to this soil. The method used generally is governed by the crop. Proper irrigation water management is needed to prevent overirrigation and erosion.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are bluegrass, brome-grasses, and wheatgrasses. Few areas of this soil have native plant cover.

Crops and the brushy areas of this soil provide food and cover for pheasant, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for urban and recreational development is the hazard of flooding. Potential frost action is a limitation for roads and streets. If tile lines are placed in the very rapidly permeable substratum, a limitation for septic tank absorption fields is the hazard of pollution of ground water by effluent.

This soil is in capability subclass IIw, irrigated.

**29-Paulson silt loam, 4 to 12 percent slopes.** This very deep, well drained soil is on mountainsides. It formed in residuum and alluvium derived from shale. Elevation is 6,000 to 7,500 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 41 degrees F, and the frost-free period is about 45 days.

Typically, the surface layer is dark grayish brown, neutral silt loam about 6 inches thick. The upper part of the subsoil is reddish gray, neutral silty clay loam about 11 inches thick. The next 27 inches is reddish brown, neutral silty clay. The lower part to a depth of 60 inches or more is reddish brown, neutral silty clay loam.

Included with this soil in mapping are small areas of Dranyon extremely stony silt loam that has slopes of 4 to 45 percent, Nielsen extremely flaggy loam that has slopes of 4 to 12 percent, Robin silt loam that has slopes of 4 to 30 percent, and a soil that is similar to this Paulson soil but has shale bedrock at a depth of 40 to 60 inches and has a thinner, darker colored surface layer.

Permeability of this Paulson soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of erosion is moderate.

Most areas of this soil are used as rangeland and for wildlife habitat. Some small areas are used for winter wheat and barley and for recreational development.

The potential native plant community is mainly mountain big sagebrush, Idaho fescue, and bluebunch wheatgrass. If the range condition deteriorates, the proportion of rabbitbrush, sagebrush, and annual forbs increases. Range seeding and brush management improve production on this soil. Crested wheatgrass, pubescent wheatgrass, and Siberian wheatgrass are suitable for seeding.

A suitable cropping system is one that includes alternate years of grain and fallow. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed. Stubble mulching, cross-slope farming, and terracing can be used to control erosion.

Crops and the brushy areas of this soil provide food and cover for mule deer, elk, moose, blue grouse, sage grouse, and coyote. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for urban and homesite development is the high shrink-swell potential, the main limitation for roads and streets is potential frost action, and the main limitation for septic tank absorption fields is moderately slow permeability. Slope limits recreational development.

This soil is in capability subclass IVe, nonirrigated.

### **30-Paulson silt loam, 12 to 30 percent slopes.**

This very deep, well drained soil is on mountainsides. It formed in residuum and alluvium derived from shale. Elevation is 6,000 to 7,500 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 41 degrees F, and the frost-free period is about 45 days.

Typically, the surface layer is dark grayish brown, neutral silt loam about 6 inches thick. The upper part of the subsoil is reddish gray, neutral silty clay loam about 11 inches thick. The next 27 inches is reddish brown, neutral silty clay. The lower part to a depth of 60 inches or more is reddish brown, neutral silty clay loam.

Included with this soil in mapping are small areas of Dranyon extremely stony silt loam that has slopes of 4 to 45 percent, Nielsen extremely flaggy loam that has slopes of 12 to 30 percent, Robin silt loam that has slopes of 4 to 30 percent, and a soil that is similar to this Paulson soil but has bedrock at a depth of 40 to 60 inches and has a thinner, darker colored surface layer.

Permeability of this Paulson soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is rapid to very rapid, and the hazard of erosion is moderate to high.

Most areas of this soil are used as rangeland. Some areas are used for wildlife habitat and recreational development.

The potential native plant community is mainly mountain big sagebrush, Idaho fescue, and bluebunch wheat-

grass. If the range condition deteriorates, the proportion of rabbitbrush, sagebrush, and annual forbs increases. Range seeding and brush management improve production on this soil. Crested wheatgrass, pubescent wheatgrass, and Siberian wheatgrass are suitable for seeding.

Brushy areas of this soil provide food and cover for mule deer, blue grouse, sage grouse, songbirds, and various birds of prey.

The main limitations for homesite development are slope, high shrink-swell potential, and low soil strength. The main limitation for roads and streets is potential frost action, and the main limitations for septic tank absorption fields are slope and the moderately slow permeability. Slope is the main limitation for recreational development.

This soil is in capability subclass VIe, nonirrigated.

**31-Paulson-Nielsen complex, 5 to 35 percent slopes.** This map unit is on mountainsides and ridges in the Tex Creek and Skyline Road area. Elevation is 6,000 to 7,500 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 41 degrees F, and the frost-free period is about 45 days.

This complex is about 55 percent Paulson silt loam and 35 percent Nielsen extremely flaggy loam. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included with this complex in mapping are small areas of Dranyon extremely stony silt loam, Robin silt loam, and Rock outcrop of sandstone, limestone, and shale.

The Paulson soil is very deep and well drained. It formed mainly in residuum and alluvium derived from shale. Typically, the surface layer is dark grayish brown, neutral silt loam about 6 inches thick. The upper part of the subsoil is reddish gray, neutral silty clay loam about 11 inches thick, the next layer is reddish brown, neutral silty clay loam about 27 inches thick, and the lower part to a depth of 60 inches or more is reddish brown, neutral silty clay loam.

Permeability of the Paulson soil is moderately slow. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of erosion is high.

The Nielsen soil is shallow and well drained. It formed in material derived from shale and sandstone. Typically, the surface layer is brown, neutral extremely flaggy loam about 6 inches thick. The subsoil is brown, neutral extremely flaggy clay loam and extremely flaggy sandy clay loam about 12 inches thick. Partially weathered and fractured sandstone is at a depth of 18 inches.

Permeability of the Nielsen soil is moderate. Available water is low. Effective rooting depth is 14 to 18 inches. Runoff is rapid, and the hazard of erosion is high.

This complex is used mainly as rangeland. Some areas are used for wildlife habitat and recreational development.

The potential plant community on this complex is mainly Idaho fescue, bluebunch wheatgrass, bluegrasses, mountain big sagebrush, and scattered patches of quaking aspen. If the range deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of unpalatable forbs and shrubs increases. Less desirable weeds and annual plants increase as the range condition further deteriorates.

This complex is best suited to livestock grazing in summer and in fall. Adequate plant cover should be maintained to prevent erosion during severe storms in summer. In most areas, seeding is a suitable practice if the range is in poor condition. Suitable plants for seeding are brome-grasses or wheatgrasses.

This complex provides habitat for mule deer, elk, moose, mourning dove, sage grouse, rabbits, and coyote. Small mammals and songbirds are common on this complex. Mourning dove is the main game bird. Proper range management practices help to maintain the wildlife habitat.

If this complex is used for construction, the main limitations are high shrink-swell potential, low soil strength, and slope on the Paulson soil and shallow depth, stones, and slope on the Nielsen soil. Shallow depth and slope limit the use of septic tank absorption fields on the Nielsen soil. Slope and stones on the Nielsen soil and slope on the Paulson soil limit recreational development.

This complex is in capability subclass VIe, nonirrigated.

**32-Pits.** Pits are excavations from which the surface layer and, commonly, the underlying material have been removed, exposing either rock or other material that supports few if any plants of economic value.

This map unit is not placed in a capability subclass.

**33-Polatis-Rock outcrop complex, 2 to 25 percent slopes.** This map unit is on loess covered basalt plains. Elevation is 4,600 to 5,400 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

This complex is about 65 percent Polatis silt loam and 25 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included with this complex in mapping are small areas of Pancheri soils and a soil that is similar to this Polatis soil but has bedrock at a depth of 10 to 20 inches.

The Polatis soil is moderately deep and well drained. It formed mainly in loess. Typically, the surface layer is light brownish gray, moderately alkaline silt loam about 6 inches thick. The subsoil is pale brown, strongly alkaline silt loam about 3 inches thick. The substratum is light gray or very pale brown, strongly alkaline silt loam about 22 inches thick. Basalt is at a depth of 31 inches.

Permeability of the Polatis soil is moderate. Available water capacity is high. Effective rooting depth is 25 to 39

inches. Runoff is very rapid, and the hazard of erosion is very high.

Rock outcrop is bare exposures of basalt that protrude through the mantle of loess. Rock outcrop resists weathering and, except for the soil material deposited in cracks and depressions, supports few plants other than lichens.

This complex is used mainly as rangeland. Some areas are used for wildlife habitat and recreational development.

The potential native plant community on this complex is mainly big sagebrush, bluebunch wheatgrass, Nevada bluegrass, and threetip sagebrush. If the range deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of unpalatable forbs and shrubs increases. Less desirable weeds and annual plants increase as the condition of the range further deteriorates.

This complex is best suited to grazing by sheep in winter and spring.

The Polatis soil produces good forage for livestock. Seeding is a suitable practice if the range is in poor condition. In places, seeding by mechanical means is limited by Rock outcrop.

This complex provides habitat for jackrabbits, pronghorn antelope, sage grouse, coyote, songbirds, and various birds of prey. Small mammals and songbirds are common. Sage grouse is the principal game bird. Proper range management practices help to maintain the quality of wildlife habitat.

The main limitations for urban development on the Polatis soil are depth to bedrock and slope, the main limitations for roads and streets are potential frost action and slope, and the main limitations for septic tank absorption fields are depth to rock, slope, and moderate permeability. The main limitations for recreational development are slope and the tendency of the soil to become dusty when dry. Rock outcrop limits excavation.

This soil is in capability subclass VIe, nonirrigated.

**34-Potell silt loam, 0 to 4 percent slopes.** This very deep, well drained soil is on south- and west-facing slopes of foothills. It formed in loess. Elevation is 4,600 to 5,300 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is light brownish gray, moderately alkaline silt loam about 6 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray, pale brown, and light gray, moderately alkaline silt loam.

Included with this soil in mapping are small areas of Ammon silt loam and Ririe silt loam.

Permeability of this Potell soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is moderate. This soil is subject to piping.

Most areas of this soil are used for dryland wheat and barley. Some small areas are used as rangeland and for wildlife habitat, recreational development, and irrigated crops such as potatoes, small grain, and alfalfa.

A suitable cropping system is one that includes alternate years of grain and summer fallow. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed. Cross-slope farming, stubble mulching, and terracing can be used to control erosion.

Sprinkler irrigation systems are suited to this unit. Proper irrigation water management is needed to prevent overirrigation, puddling, and erosion.

The potential native plant community is mainly big sagebrush and bluebunch wheatgrass. If the range condition deteriorates, the proportion of cheatgrass, rabbitbrush, and Canada thistle increases. Range seeding and brush management improve production on this soil. Crested wheatgrass, pubescent wheatgrass, Siberian wheatgrass, and bluebunch wheatgrass are suitable for seeding.

Crops and the brushy areas of this soil provide food and cover for Hungarian partridge, mourning dove, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for recreational development is the tendency of the soil to become dusty when dry, the main limitation for septic tank absorption fields is the moderate permeability, and the main limitation for roads and streets is potential frost action.

This soil is in capability subclasses VIe, nonirrigated, and IIe, irrigated.

**35-Potell silt loam, 4 to 12 percent slopes.** This very deep, well drained soil is on south- and west-facing slopes of foothills. It formed in loess. Elevation is 4,600 to 5,300 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is light brownish gray, moderately alkaline silt loam about 6 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray, pale brown, and light gray, moderately alkaline silt loam.

Included with this soil in mapping are small areas of Ririe silt loam.

Permeability of this Potell soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium to rapid, and the hazard of erosion is high. This soil is subject to piping.

Most areas of this soil are used for dryland wheat and barley. Some small areas are used as rangeland, for wildlife habitat and recreational development, and for irrigated crops such as potatoes, small grain, and alfalfa.

A suitable cropping system is one that includes alternate years of grain and summer fallow. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed. Cross-slope farming, stubble mulching, and terracing can be used to control erosion. Proper design of sprinkler irrigation systems is needed to prevent overirrigation and erosion.

The potential native plant community is mainly big sagebrush and bluebunch wheatgrass. If the range condition deteriorates, the proportion of cheatgrass, rabbitbrush, and Canada thistle increases. Range seeding and brush management improve production on this soil. Crested wheatgrass, pubescent wheatgrass, and Siberian wheatgrass are suitable for seeding.

Crops and the brushy areas of this soil provide food and cover for Hungarian partridge, mourning dove, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for urban development is slope, the main limitations for septic tank absorption fields are moderate permeability and slope, and the main limitation for roads and streets is potential frost action. The main limitations for recreational development are slope and the tendency of the soil to become dusty when dry.

This soil is in capability subclasses IVe, irrigated, and VIe, nonirrigated.

**36-Potell silt loam, 12 to 20 percent slopes.** This very deep, well drained soil is on south- and west-facing slopes of foothills. It formed in loess. Elevation is 4,600 to 5,300 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is light brownish gray, moderately alkaline silt loam about 6 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray, pale brown, and light gray, moderately alkaline silt loam.

Included with this soil in mapping are small areas of Ririe silt loam.

Permeability of this Potell soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is rapid to very rapid, and the hazard of erosion is very high. This soil is subject to piping.

Most areas of this soil are used for dryland wheat and barley. Some small areas are used as rangeland and for wildlife habitat and recreational development.

A suitable cropping system is one that includes alternate years of grain and summer fallow. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed. Cross-slope farming, stubble mulching, and terracing can be used to control erosion.

The potential native plant community is mainly big sagebrush and bluebunch wheatgrass. If the range condition deteriorates, the proportion of cheatgrass, rabbitbrush, and Canada thistle increases. Range seeding and brush management improve production on this soil. Crested wheatgrass, pubescent wheatgrass, and Siberian wheatgrass are suitable for seeding.

Crops and the brushy areas of this soil provide food and cover for Hungarian partridge, mourning dove, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for homesite and recreational development is slope, the main limitations for roads and streets are slope and potential frost action, and the main limitation for septic tank absorption fields is slope.

This soil is in capability subclass VIe, nonirrigated.

**37-Potell silt loam, 20 to 30 percent slopes.** This very deep, well drained soil is on south- and west-facing slopes of foothills. It formed in loess. Elevation is 4,600 to 5,300 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is light brownish gray, moderately alkaline silt loam about 6 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray, pale brown, and light gray, moderately alkaline silt loam.

Included with this soil in mapping are small areas of Ririe silt loam.

Permeability of this Potell soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of erosion is very high. This soil is subject to piping.

Most areas of this soil are used as rangeland. Some areas are used for wildlife habitat and homesite development.

The potential native plant community is mainly big sagebrush and bluebunch wheatgrass. If the range condition deteriorates, the proportion of cheatgrass, rabbitbrush, and Canada thistle increases. Range seeding and brush management improve production on this soil. Seeding is limited by steepness of slope. Crested wheat-

grass, pubescent wheatgrass, Siberian wheatgrass, and bluebunch wheatgrass are suitable for seeding.

The main limitation for homesite and recreational development is slope, and the main limitations for roads and streets are slope and potential frost action.

This soil is in capability subclass VIe, nonirrigated.

**38-Potell silt loam, 30 to 60 percent slopes.** This very deep, well drained soil is on south- and west-facing slopes of foothills. It formed in loess. Elevation is 4,600 to 5,300 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is light brownish gray, moderately alkaline silt loam about 6 inches thick. The underlying material to a depth of 60 inches or more is light brownish gray, pale brown, and light gray, moderately alkaline silt loam.

Included With this soil in mapping are small areas of Ririe silt loam that has slopes of 20 to 30 percent.

Permeability of this Potell soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of erosion is very high.

Most areas of this soil are used as rangeland and for wildlife habitat.

The potential native plant community is mainly big sagebrush and bluebunch wheatgrass. If the range condition deteriorates, the proportion of cheatgrass, rabbitbrush, and Canada thistle increases. Range seeding and brush management are limited by steep slopes.

The brushy areas of this soil provide food and cover for Hungarian partridge, mourning dove, songbirds, and various birds of prey. Lack of adequate cover limits the wildlife population.

This soil is in capability subclass VIIe.

**39-Rin silt loam, 4 to 12 percent slopes.** This very deep, well drained soil is on north-facing mountainsides. It formed in loess. Elevation is 5,500 to 7,000 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 41 degrees F, and the frost-free period is about 60 days.

Typically, the surface layer is dark grayish brown, neutral silt loam about 28 inches thick. The subsoil to a depth of 60 inches or more is brown and pale brown, neutral silt loam.

Included with this unit in mapping are small areas of Ririe silt loam that has slopes of 4 to 12 percent, Robin silt loam that has slopes of 4 to 30 percent, Tetonia silt loam that has slopes of 4 to 12 percent, and a soil that is similar to this Rin soil but has bedrock at a depth of less than 40 inches.

Permeability of this Rin soil is moderate. Available water capacity is very high. Effective rooting depth is 60

inches or more. Runoff is rapid, and the hazard of erosion is moderate.

Most areas of this soil are used for winter wheat and as rangeland. Some areas are used for wildlife habitat and recreational development.

The potential native plant community is mainly bluebunch wheatgrass, slender wheatgrass, Woods rose, snowberry, and serviceberry. Areas of scrubby aspen are on the included soils of this map unit. If the range condition deteriorates, the proportion of rabbitbrush and annual forbs increases. Range seeding and brush management improve production on this soil. Crested wheatgrass, pubescent wheatgrass, and Siberian wheatgrass are suitable for seeding.

A suitable cropping system is one that includes alternate years of grain and fallow. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed. Cross-slope farming, stubble mulching, and terracing can be used to control erosion.

Crops and the brushy areas of this soil provide food and cover for mule deer, moose, ruffed grouse, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for homesite and recreational development is slope, the main limitations for septic tank absorption fields are moderate permeability and slope, and the main limitation for roads and streets is potential frost action.

This soil is in capability subclass IVe, nonirrigated.

**40-Rin silt loam, 12 to 45 percent slopes.** This very deep, well drained soil is on north-facing mountainsides. It formed in loess. Elevation is 5,500 to 7,000 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 41 degrees F, and the frost-free period is about 60 days.

Typically, the surface layer is dark grayish brown, neutral silt loam about 28 inches thick. The subsoil to a depth of 60 inches or more is brown and pale brown, neutral silt loam.

Included with this soil in mapping are small areas of Ririe silt loam that has slopes of 12 to 30 percent, Robin silt loam that has slopes of 4 to 30 percent, Tetonia silt loam that has slopes of 12 to 30 percent, and a soil that is similar to this Rin soil but has bedrock at a depth of less than 40 inches.

Permeability of this Rin soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of erosion is moderate.

Most areas of this soil are used as rangeland. Some areas are used for wildlife habitat and recreational development.

The potential native plant community is mainly bluebunch wheatgrass, slender wheatgrass, Woods rose, snowberry and serviceberry. Areas of scrubby aspen are on the included soils of this unit. If the range condition deteriorates, the proportion of aspen and annual forbs increases. Range seeding and brush management improve production on this soil. Seeding is limited on slopes of more than 30 percent. Crested wheatgrass, pubescent wheatgrass, and Siberian wheatgrass are suitable for seeding.

The brushy areas of this soil provide food and cover for mule deer, moose, ruffed grouse, songbirds, and various birds of prey. Proper range management practices help to maintain the habitat for wildlife. Lack of adequate cover limits the Wildlife population.

The main limitation for homesite and recreational development is slope. Potential frost action is a limitation for roads.

This soil is in capability subclass VIe, nonirrigated.

**41-Ririe silt loam, 0 to 4 percent slopes.** This very deep, well drained soil is on south- and west-facing slopes of foothills. It formed in loess. Elevation is 5,200 to 6,200 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 42 degrees F, and the frost-free period is about 85 days.

Typically the surface layer is dark grayish brown, mildly alkaline silt loam about 8 inches thick. The subsoil is grayish brown, mildly alkaline silt loam about 7 inches thick. The substratum to a depth of 60 inches or more is white, light gray, and gray, moderately alkaline silt loam.

Included with this soil in mapping are small areas of Araveton extremely stony loam that has slopes of 4 to 30 percent of Maim fine sandy loam that has slopes of 4 to 12 percent, Potell silt loam that has slopes of 0 to 4 percent, Rin silt loam that has slopes of 4 to 12 percent, Tetonia silt loam that has slopes of 0 to 4 percent, and a soil that is similar to this Ririe soil but has bedrock at a depth of less than 40 inches. Also included, in swales and depressions, are small areas of soils that have a thicker, darker colored surface layer.

Permeability of this Ririe soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used for nonirrigated winter wheat and barley. Some small areas are used for irrigated crops such as potatoes, small grain, and alfalfa and for wildlife habitat and recreational development.

If this soil is used for crops, yields are limited by the cool climate. A suitable cropping system is one that includes alternate years of grain and summer fallow. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is

needed. Cross-slope farming, stubble mulching, and terracing can be used to control erosion. Proper sprinkler irrigation design is needed to prevent overirrigation, erosion, and puddling.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are smooth brome and wheatgrasses. Few areas of this soil have native plant cover.

Crops and the brushy areas of this soil provide food and cover for Hungarian partridge, mourning dove, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for septic tank absorption fields is moderate permeability, and the main limitation for roads and streets is potential frost action.

This soil is in capability subclasses IIIc, nonirrigated, and IIIe, irrigated.

**42-Rirle silt loam, 4 to 12 percent slopes.** This very deep, well drained soil is on south- and west-facing slopes of foothills. It formed in loess. Elevation is 5,200 to 6,200 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 42 degrees F, and the frost-free period is about 85 days.

Typically, the surface layer is dark grayish brown, mildly alkaline silt loam about 8 inches thick. The subsoil is grayish brown, mildly alkaline silt loam about 7 inches thick. The substratum to a depth of 60 inches or more is light gray and gray, moderately alkaline silt loam.

Included with this soil in mapping are small areas of Araveton extremely stony loam that has slopes of 4 to 30 percent, and Malm fine sandy loam, Potell silt loam, Rin silt loam, and Tetonia silt loam that have slopes of 4 to 12 percent. Also included is a soil that is similar to this Ririe soil but has bedrock at a depth of less than 40 inches and soils, in swales and depressions, that have a thicker, darker colored surface layer.

Permeability of this Ririe soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are used for nonirrigated winter wheat and barley. Some small areas are used for irrigated crops such as potatoes, small grain, and alfalfa and for wildlife habitat and recreational development.

If this soil is used for crops, yields are limited by the cool climate.

A suitable cropping system is one that includes alternate years of grain and summer fallow. Tillage should be kept to a minimum, and crop residue should be returned

to the soil. Chemical weed control is needed. Contour farming, stubble mulching, and terracing can be used to control erosion. Proper design of sprinklers is needed to prevent overirrigation and erosion.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are smooth brome and wheatgrasses. Few areas of this soil have native plant cover.

Crops and the brushy areas of this soil provide food and cover for Hungarian partridge, mourning dove, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for urban and recreational development is slope, the main limitations for septic tank absorption fields are moderate permeability and slope, and the main limitation for roads and streets is potential frost action.

This soil is in capability subclasses IVe, irrigated, and IIIe, nonirrigated.

**43-Ririe silt loam, 12 to 20 percent slopes.** This very deep, well drained soil is on south- and west-facing slopes of foothills. It formed in loess. Elevation is 5,200 to 6,200 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 85 days.

Typically, the surface layer is dark grayish brown, mildly alkaline silt loam about 8 inches thick. The subsoil is grayish brown, mildly alkaline silt loam about 7 inches thick. The substratum to a depth of 60 inches or more is light gray and gray, moderately alkaline silt loam.

Included with this soil in mapping are small areas of Araveton extremely stony loam that has slopes of 4 to 30 percent, Malm fine sandy loam and Potell silt loam that have slopes of 12 to 20 percent, Rin silt loam that has slopes of 12 to 45 percent, Tetonia silt loam that has slopes of 12 to 20 percent, and a soil that is similar to this Ririe soil but has bedrock at a depth of less than 40 inches. Also included are small areas of soils, on ridges, that have a thinner surface layer because of erosion.

Permeability of this Ririe soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of erosion is very high.

Most areas of this soil are used for nonirrigated winter wheat and barley and as rangeland. Some areas are used for wildlife habitat and recreational development.

A suitable cropping system is one that includes alternate years of grain and summer fallow. Tillage should be

kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed. Cross-slope farming, stubble mulching, and terracing can be used to control erosion.

The potential native plant community is mainly mountain big sagebrush, bitterbrush, bluebunch wheatgrass, and slender wheatgrass. If the range condition deteriorates, the proportion of rabbitbrush, sagebrush, and annual forbs increases. Range seeding and brush management improve production on this soil. Seeding is limited by steepness of slope. Pubescent wheatgrass and intermediate wheatgrass are suitable for seeding.

Crops and the brushy areas of this soil provide food and cover for Hungarian partridge, mourning dove, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using an adequate cropping system.

The main limitation for urban and recreational development is slope, and the main limitations for roads and streets are slope and potential frost action.

This soil is in capability subclass IIIe, nonirrigated.

**44-Ririe silt loam, 20 to 30 percent slopes.** This very deep, well drained soil is on south- and west-facing slopes of foothills. It formed in loess. Elevation is 5,200 to 6,200 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 42 degrees F, and the frost-free period is about 85 days.

Typically, the surface layer is dark grayish brown, mildly alkaline silt loam about 8 inches thick. The subsoil is grayish brown, mildly alkaline silt loam about 7 inches thick. The substratum to a depth of 60 inches or more is light gray and gray, moderately alkaline silt loam.

Included with this soil in mapping are small areas of Araveton extremely stony loam that has slopes of 4 to 30 percent, Malm fine sandy loam that has slopes of 12 to 20 percent, Potell silt loam that has slopes of 20 to 30 percent, Rin silt loam that has slopes of 12 to 45 percent, Tetonia silt loam that has slopes of 20 to 30 percent, and a soil that is similar to this Ririe soil but has bedrock at a depth of less than 40 inches. Also included are small areas of eroded soils, on ridges, that are similar to this Ririe soil but have a thinner surface layer.

Permeability of this Ririe soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of erosion is very high.

Most areas of this soil are used as rangeland. Some areas are used for wildlife habitat and homesite development.

The potential plant community is mainly mountain big sagebrush, bitterbrush, bluebunch wheatgrass, and slender wheatgrass. If the range condition deteriorates, the proportion of rabbitbrush, sagebrush, and annual forbs

increases. Range seeding and brush management improve production on this soil. Seeding is limited by steepness of slope. Pubescent wheatgrass and intermediate wheatgrass are suitable for seeding.

The brushy areas of this soil provide food and cover for mule deer, Hungarian partridge, mourning dove, songbirds, and various birds of prey.

The main limitation for homesite and recreational development is slope, and the main limitations for roads and streets are slope and potential frost action.

This soil is in capability subclass VIe, nonirrigated.

#### **45-Ririe-Rock outcrop complex, 4 to 30 percent slopes.**

This map unit is on south- and west-facing slopes of foothills in the Antelope Flat drainageway and Willow Creek. Elevation is 5,200 to 6,200 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 42 degrees F, and the frost-free period is about 85 days.

This complex is about 60 percent Ririe silt loam and 20 percent Rock outcrop. The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included with this complex in mapping are small areas of Rin silt loam, Tetonia silt loam, and Potell silt loam.

The Ririe soil is very deep and well drained. It formed mainly in loess. Typically, the surface layer is dark grayish brown, mildly alkaline silt loam about 8 inches thick. The subsoil is grayish brown, mildly alkaline silt loam about 7 inches thick. The substratum to a depth of 60 inches or more is white, light gray, and gray, moderately alkaline silt loam.

Permeability of the Ririe soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is slow to rapid, and the hazard of erosion is slight to high.

Rock outcrop is rhyolite tuff that is covered in places by weathered fragments mixed with loess and residuum. The plant cover is sparse.

Most areas of this soil are used as rangeland and for wildlife habitat. Some areas are used for recreational development.

The potential plant community on this complex is mainly mountain big sagebrush, bluebunch wheatgrass, slender wheatgrass, and bitterbrush. If the range condition deteriorates, the proportion of bluebunch wheatgrass decreases and the proportion of unpalatable forbs and shrubs increases. Less desirable weeds and annual plants increase as the range condition further deteriorates.

This complex is best suited to livestock grazing in summer and fall.

The Ririe soil produces forage suitable for livestock, but Rock outcrop produces sparse forage. Seeding is a good practice if the range is in poor condition. In some places, seeding is limited by steepness of slope and



Rock outcrop. Pubescent wheatgrass and intermediate wheatgrass are suitable for seeding.

This complex provides habitat for cottontail rabbit, mourning dove, sage grouse, Hungarian partridge, songbirds, and various birds of prey. Small mammals and songbirds are common. Hungarian partridge is the principal game bird. Proper range management practices help to maintain the wildlife habitat.

The main limitation of this complex for construction is slope. Potential frost action and slope limit its use for roads and streets. Excavation is limited by Rock outcrop.

This complex is in capability subclass VIe, nonirrigated.

**46-Robin silt loam, 4 to 30 percent slopes.** This very deep, well drained soil is on north-facing slopes. It formed in loess. Elevation is 6,000 to 7,500 feet. The average annual precipitation is about 20 inches, the average annual air temperature is about 41 degrees F, and the frost-free period is about 40 days.

Typically, the upper part of the surface layer is dark grayish brown, slightly acid silt loam about 18 inches thick. The lower part is brown, neutral silt loam about 7 inches thick. The subsoil to a depth of 60 inches or more is brown, neutral silty clay loam.

Included with this soil in mapping are small areas of Dranyon extremely stony silt loam that has slopes of 4 to 45 percent, Lanark silt loam that has slopes of 4 to 20 percent, Paulson silt loam that has slopes of 12 to 30 percent, Rin silt loam that has slopes of 12 to 45 percent, Tetonia silt loam that has slopes of 12 to 20 percent, and a soil that is similar to this Robin soil but has bedrock at a depth of less than 40 inches.

Permeability of this Robin soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium to rapid, and the hazard of erosion is moderate to high.

Most areas of this soil are used as rangeland. Some small areas are used for wildlife habitat and recreational development.

The potential native plant community is mainly Idaho fescue, mountain brome, mountain big sagebrush, and bitterbrush. If the range condition deteriorates, the proportion of rabbitbrush, sagebrush, and annual forbs increases. Areas of scrubby aspen are on the included soils of this map unit. Range seeding and brush management improve production on this soil. Seeding is limited by steepness of slope. Pubescent wheatgrass and intermediate wheatgrass are suitable for seeding.

The brushy areas of this soil provide food and cover for mule deer, moose, ruffed. grouse, and snowshoe rabbit. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds.

The main limitation for homesite and recreational development is slope, and the main limitations for roads and streets are slope and potential frost action.

This soil is in capability subclass VIe, nonirrigated.

**47-Stan sandy loam.** This very deep, well drained soil is on flood plains along the Snake River. It formed in alluvium derived from mixed sources. Slope is 0 to 2 percent. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is brown, mildly alkaline sandy loam about 13 inches thick. The subsoil is pale brown, mildly alkaline sandy loam and fine sandy loam about 21 inches thick. The upper part of the substratum is very pale brown, mildly alkaline fine sandy loam about 21 inches thick. The lower part to a depth of 60 inches or more is very pale brown, mildly alkaline extremely gravelly coarse sand.

Included with this soil in mapping are small areas of Bock loam and Bannock loam that have slopes of 0 to 2 percent, and Wolverine sand that has slopes of 0 to 20 percent.

Permeability of this Stan soil is moderately rapid. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used for irrigated crops. Some areas are used for wildlife habitat. Expansion of the city of Idaho Falls has resulted in some urban development on this soil.

This soil is well suited to irrigated crops such as potatoes, small grain, hay, and pasture. Yields are limited by the cool climate.

A suitable cropping system is one that includes 3 to 4 years of alfalfa, 2 years of potatoes, and 1 to 2 years of grain. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed.

Proper irrigation water management is needed to prevent overirrigation and erosion. The method of irrigation used is governed by the crop. If furrow irrigation is used, water should be applied at frequent intervals and runs should be short.

Suitable grazing management practices for alfalfa or grass are rotation grazing during the growing season and delaying grazing until the stubble reaches a minimum height. Plants suitable for grazing are bluegrasses, brome-grasses, and wheatgrasses. Few areas of this soil have native plant cover.

Crops and the brushy areas of this soil provide food and cover for pheasant, mourning dove, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for septic tank absorption fields is the hazard of pollution of ground water by effluent, and

the main limitation for roads and streets is potential frost action.

This soil is in capability subclass IIe, irrigated.

**48-Tetonia silt loam, 0 to 4 percent slopes.** This very deep, well drained soil is on north- and east-facing mountainsides. It formed in loess. Elevation is 5,500 to 7,000 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 42 degrees F, and the frost-free period is about 75 days.

Typically, the surface layer is grayish brown, mildly alkaline silt loam about 8 inches thick. The upper part of the subsoil is grayish brown, mildly alkaline silt loam about 14 inches thick. The lower part is light brownish gray, moderately alkaline silt loam about 14 inches thick. The substratum to a depth of 60 inches or more is light gray, moderately alkaline silt loam.

Included with this soil in mapping are small areas of Araveton extremely stony loam that has slopes of 4 to 30 percent, Lanark silt loam that has slopes of 4 to 20 percent, Rin silt loam that has slopes of 4 to 12 percent, Ririe silt loam that has slopes of 0 to 4 percent, Robin silt loam that has slopes of 4 to 30 percent, and a soil that is similar to this Tetonia soil but has bedrock at a depth of 40 to 60 inches.

Permeability of this Tetonia soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight.

Most areas of this soil are used for nonirrigated winter wheat. Some small areas are used as rangeland and for wildlife habitat, recreational development, and irrigated seed potatoes.

If this soil is used for crops, yields are limited by the short growing season.

A suitable cropping system is one that includes alternate years of grain and fallow. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed. Stubble mulching, cross-slope farming, and terracing can be used to control erosion. Proper design of sprinklers is needed to prevent overirrigation and erosion.

The potential native plant community is mainly mountain big sagebrush, bitterbrush, bluebunch wheatgrass, and slender wheatgrass. If the range condition deteriorates, the proportion of rabbitbrush, sagebrush, and annual forbs increases. Range seeding and brush management improve production on this soil. Crested wheatgrass, pubescent wheatgrass, and Siberian wheatgrass are suitable for seeding.

Crops and the brushy areas of this soil provide food and cover for mourning dove, Hungarian partridge, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by

managing crop residue and using an adequate cropping system.

The main limitation for septic tank absorption fields is moderate permeability, and the main limitation for roads and streets is potential frost action.

This soil is in capability subclasses IVe, irrigated, and IVc, nonirrigated.

**49-Tetonia silt loam, 4 to 12 percent slopes.** This very deep, well drained soil is on north- and east-facing mountainsides. It formed in loess. Elevation is 5,500 to 7,000 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 42 degrees F, and the frost-free period is about 75 days.

Typically, the surface layer is grayish brown, mildly alkaline silt loam about 8 inches thick. The upper part of the subsoil is grayish brown, mildly alkaline silt loam about 14 inches thick. The lower part is light brownish gray, mildly alkaline silt loam about 14 inches thick. The substratum to a depth of 60 inches or more is light gray, moderately alkaline silt loam.

Included with this soil in mapping are small areas of Araveton extremely stony loam that has slopes of 4 to 30 percent, Lanark silt loam that has slopes of 4 to 20 percent, Ririe silt loam that has slopes of 4 to 12 percent, Rin silt loam that has slopes of 4 to 12 percent, Robin silt loam that has slopes of 4 to 30 percent, and a soil that is similar to this Tetonia soil but has bedrock at a depth of 40 to 60 inches.

Permeability of this Tetonia soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is medium, and the hazard of erosion is moderate.

Most areas of this soil are used for nonirrigated winter wheat. Some small areas are used as rangeland and for wildlife habitat, irrigated seed potatoes, and recreational development.

If this soil is used for crops, yields are limited by the short growing season.

The potential native plant community is mainly mountain big sagebrush, bitterbrush, bluebunch wheatgrass, and slender wheatgrass. If the range condition deteriorates, the proportion of rabbitbrush, sagebrush, and annual forbs increases. Range seeding and brush management improve production on this soil. Crested wheatgrass, pubescent wheatgrass, and Siberian wheatgrass are suitable for seeding.

A suitable cropping system is one that includes alternate years of grain and fallow. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed. Stubble mulching, cross-slope farming, and terracing can be used to control erosion. Proper design of sprinkler irrigation systems is needed to prevent overirrigation and erosion.

Crops and the brushy areas of this soil provide food and cover for mourning dove, Hungarian partridge, songbirds, and various birds of prey. Migrating ducks and

some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using an adequate cropping system.

The main limitation for homesite and recreational development is slope, the main limitation for septic tank absorption fields is moderate permeability, and the main limitation for roads and streets is potential frost action.

This soil is in capability subclasses IVe, irrigated, and IVe, nonirrigated.

**50-Tetonia silt loam, 12 to 20 percent slopes.** This very deep, well drained soil is on north- and east-facing mountainsides. It formed in loess. Elevation is 5,500 to 7,000 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 42 degrees F, and the frost-free period is about 75 days.

Typically, the surface layer is grayish brown, mildly alkaline silt loam about 8 inches thick. The upper part of the subsoil is grayish brown, mildly alkaline silt loam about 14 inches thick. The lower part is light brownish gray, mildly alkaline silt loam about 14 inches thick. The substratum to a depth of 60 inches or more is light gray, moderately alkaline silt loam.

Included with this soil in mapping are small areas of Araveton extremely stony loam that has slopes of 4 to 30 percent, Lanark silt loam that has slopes of 4 to 20 percent, Rin silt loam that has slopes of 12 to 45 percent, Ririe silt loam that has slopes of 12 to 20 percent, Robin silt loam that has slopes of 4 to 30 percent, and a soil that is similar to this Tetonia soil but has bedrock at a depth of 40 to 60 inches.

Permeability of this Tetonia soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of erosion is very high.

Most areas of this soil are used for nonirrigated winter wheat. Some small areas are used as rangeland and for wildlife habitat and recreational development.

If this soil is used for crops, yields are limited by the short growing season. Farm machinery is difficult to operate on the steeper slopes.

The potential native plant community is mainly mountain big sagebrush, bitterbrush, bluebunch wheatgrass, and slender wheatgrass. If the range condition deteriorates, the proportion of rabbitbrush, sagebrush, and annual forbs increases. Range seeding and brush management improve production on this soil. Crested wheatgrass, pubescent wheatgrass, and Siberian wheatgrass are suitable for seeding.

A suitable cropping system is one that includes alternate years of grain and fallow. Tillage should be kept to a minimum, and crop residue should be returned to the soil. Chemical weed control is needed. Stubble mulching,

cross-slope farming, and terracing can be used to control erosion.

Crops and the brushy areas of this soil provide food and cover for mourning dove, Hungarian partridge, songbirds, and various birds of prey. Migrating ducks and some Canadian geese feed in the harvested grainfields. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds. Wildlife habitat is improved by managing crop residue and using a suitable cropping system.

The main limitation for homesite and recreational development is slope, and the main limitations for roads and streets are slope and potential frost action.

This soil is in capability subclass IVe, nonirrigated.

**51-Tetonia silt loam, 20 to 30 percent slopes.** This very deep, well drained soil is on north- and east-facing mountainsides. It formed in loess. Elevation is 5,500 to 7,000 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 42 degrees F, and the frost-free period is about 75 days.

Typically, the surface layer is grayish brown, mildly alkaline silt loam about 8 inches thick. The upper part of the subsoil is grayish brown, mildly alkaline silt loam about 14 inches thick. The lower part is light brownish gray, mildly alkaline silt loam about 14 inches thick. The substratum to a depth of 60 inches or more is light gray, moderately alkaline silt loam.

Included with this soil in mapping are small areas of Araveton extremely stony loam that has slopes of 4 to 30 percent, Lanark silt loam that has slopes of 20 to 45 percent, Rin silt loam that has slopes of 12 to 45 percent, Ririe silt loam that has slopes of 20 to 30 percent, Robin silt loam that has slopes of 4 to 30 percent, and a soil that is similar to this Tetonia soil but has bedrock at a depth of 40 to 60 inches.

Permeability of this Tetonia soil is moderate. Available water capacity is very high. Effective rooting depth is 60 inches or more. Runoff is very rapid, and the hazard of erosion is very high.

Most areas of this soil are used as rangeland. Some areas are used for wildlife habitat and recreational development.

The potential native plant community is mainly mountain big sagebrush, bitterbrush, bluebunch wheatgrass, and slender wheatgrass. If the range condition deteriorates, the proportion of rabbitbrush, sagebrush, and annual forbs increases. Range seeding and brush management improve production on this soil. Seeding is limited by steepness of slope. Crested wheatgrass, pubescent wheatgrass, and Siberian wheatgrass are suitable for seeding.

The brushy areas of this soil provide food and cover for mule deer, moose, blue grouse, mourning dove, songbirds, and various birds of prey. Lack of adequate cover limits the wildlife population.

The main limitation for homesite and recreational development is slope, and the main limitations for roads and streets are slope and potential frost action.

This soil is in capability subclass VIe, nonirrigated.

**52-Torriorthents-Rock outcrop complex, very steep.** This map unit is on south- and west-facing mountainsides and sides of canyons in the southeastern part of the survey area. Elevation is 4,700 to 6,200 feet. The average annual precipitation is about 12 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 85 days.

This complex is about 60 percent Torriorthents and 30 percent Rock outcrop.

Included with this complex in mapping are small areas of Araveton extremely stony loam, Potell silt loam, and Ririe silt loam. Also included are small areas of colder soils on north- and east-facing slopes.

Torriorthents are shallow to very deep and well drained. They formed mainly in colluvium derived from volcanic rock, shale, or sandstone. Slope is 35 to 65 percent. The surface layer is light-colored silt loam and bouldery or stony loam about 6 inches thick. The underlying material is light-colored silt loam to gravelly, stony, or bouldery clay 14 to 54 inches thick. Content of rock fragments is 0 to 80 percent. Reaction is mildly alkaline to strongly alkaline.

Permeability of Torriorthents is slow to rapid. Available water capacity is low to high. Effective rooting depth generally is 20 to 60 inches. Runoff is very rapid, and the hazard of erosion is very high.

Rock outcrop generally is rims of exposed rhyolite and basalt bedrock along the canyon walls. Small areas of scattered sandstone or shale are present.

This complex is used mainly for wildlife habitat.

The potential native plant community on this complex is mainly Indian ricegrass, big sagebrush, and other shrubs. If the range condition deteriorates, the proportion of Indian ricegrass decreases and the proportion of unpalatable forbs and shrubs increases. Less desirable weeds and annual plants increase as the range condition further deteriorates.

This complex produces limited forage for livestock. Steepness of slope and the very high hazard of erosion make it difficult to manage.

This complex provides habitat for Hungarian partridge, sage grouse, mourning dove, rabbit, coyote, and mule deer. Small mammals and songbirds are common. Mourning dove is the principal game bird. Proper range management practices help to maintain the quality of wildlife habitat.

Steepness of slope limits the use of Torriorthents for homesite and recreational development. Rock outcrop limits excavation.

This soil is in capability subclass VIe, nonirrigated.

**53-Wolverine sand, 0 to 20 percent slopes.** This very deep, excessively drained soil is on sand dunes on river terraces. It formed in eolian sand. Elevation is 4,600 to 5,500 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

Typically, the surface layer is light brownish gray, mildly alkaline sand about 5 inches thick. The underlying material to a depth of 60 inches or more is pale brown, mildly alkaline sand.

Included with this soil in mapping are small areas of Stan sandy loam that has slopes of 0 to 4 percent.

Permeability of this Wolverine soil is very rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is very high. The hazard of soil blowing is high if a protective cover is not maintained.

Most areas of this soil are used as rangeland and for wildlife habitat. Some areas are used for recreational development.

The potential native plant community is mainly needleandthread, Indian ricegrass, yellow wildrye, prairie junegrass, bottlebrush squirreltail, and big sagebrush. If the range condition deteriorates, the proportion of rabbitbrush and big sagebrush increases. Range seeding in deteriorated areas is limited by unstable dunes. Careful management is needed to leave enough vegetation to stabilize the dunes.

The brushy areas of this soil provide food and cover for jackrabbits, mourning dove, pheasant, songbirds, and various birds of prey.

The main limitation for urban development is slope, the main limitations for septic tank absorption fields are very rapid permeability and slope, and the main limitation for recreational development and excavation is the sandy texture.

This soil is in capability subclass VIe, nonirrigated.

**54-Xeric Torrifluvents, channeled.** These very deep, well drained, nearly level to sloping soils are on lower river terraces and islands. They formed in mixed alluvium. Slope is 0 to 8 percent. Elevation is 4,600 to 5,500 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 110 days.

The surface layer is dark-colored, mildly alkaline loam or sandy loam to gravelly loam or gravelly sandy loam about 10 inches thick. The underlying material to a depth of 60 inches or more is lighter colored, moderately alkaline gravelly loam or gravelly sandy loam to very gravelly loam or very gravelly sandy loam.

Included with these soils in mapping are small areas of Harston fine sandy loam, Heiseton fine sandy loam, and a soil that is similar to Xeric Torrifluvents but has basalt at a depth of 40 to 60 inches. All of the included soils have slopes of 0 to 4 percent.

Permeability of Xeric Torrifluvents is moderate to rapid. Available water capacity is low. Effective rooting depth is 60 inches or more. Runoff is slow, and the hazard of erosion is slight.

Most areas of these soils are used as rangeland and for wildlife habitat. Some areas are used for recreational development.

The potential native plant community is mainly bluebunch wheatgrass, sedges, and cottonwood. If the range condition deteriorates, the proportion of annual forbs and shrubs increases.

The brushy areas of these soils provide food and cover for pheasant, cottontail, coyote, songbirds, and various birds of prey. Lack of adequate cover limits the wildlife population. Planting shrubs and windbreaks provides cover and food for upland game birds.

The main limitation for urban and recreational development is the hazard of flooding, and the main limitation for septic tank absorption fields is the hazard of pollution of ground water by effluent.

These soils are in capability subclass VIIw.

## Use and management of the soils

This soil survey is an inventory and evaluation of the soils in the survey area. It can be used to adjust land uses to the limitations and potentials of natural resources and the environment. Also, it can help avoid soil-related failures in land uses.

In preparing a soil survey, soil scientists, conservationists, engineers, and others collect extensive field data about the nature and behavior characteristics of the soils. They collect data on erosion, droughtiness, flooding, and other factors that affect various soil uses and management. Field experience and collected data on soil properties and performance are used as a basis in predicting soil behavior.

Information in this section can be used to plan the use and management of soils for crops and pasture; as rangeland and woodland; as sites for buildings, sanitary facilities, highways and other transportation systems, and parks and other recreation facilities; and for wildlife habitat. It can be used to identify the potentials and limitations of each soil for specific land uses and to help prevent construction failures caused by unfavorable soil properties.

Planners and others using soil survey information can evaluate the effect of specific land uses on productivity and on the environment in all or part of the survey area. The survey can help planners to maintain or create a land use pattern in harmony with the natural soil.

Contractors can use this survey to locate sources of sand and gravel, roadfill, and topsoil. They can use it to identify areas where bedrock, wetness, or very firm soil layers can cause difficulty in excavation.

Health officials, highway officials, engineers, and others may also find this survey useful. The survey can help them plan the safe disposal of wastes and locate sites for pavements, sidewalks, campgrounds, playgrounds, lawns, and trees and shrubs.

## Crops and pasture

General management needed for crops and pasture is suggested in this section. The crops or pasture plants best suited to the soils, including some not commonly grown in the survey area, are identified; the estimated yields of the main crops and hay and pasture plants are listed for each soil; the system of land capability classification used by the Soil Conservation Service is explained.

Planners of management systems for individual fields or farms should consider the detailed information given in the description of each soil under "Soil maps for detailed planning." Specific information can be obtained from the local office of the Soil Conservation Service or the Cooperative Extension Service.

In 1977 about 368,000 acres in Bonneville County Area was used for cropland. Of this total, 169,000 acres was irrigated and 199,000 acres was nonirrigated. Winter wheat was grown on about 53,000 acres, spring wheat on about 29,500 acres, and barley on about 51,500 acres. About 44,000 acres of potatoes are grown annually. Sugar beets and oats are grown in small areas. Alfalfa and an alfalfa-grass mixture are grown for hay.

Areas used for cropland have not increased significantly in recent years. Much of the acreage is now being used for urban development, and this trend is expected to continue.

Soil erosion is the major limitation for nonirrigated cropland. About 23 percent of the survey area is Potell, Rin, Ririe, and Tetonia soils that have slopes of more than 4 percent. Some dryland fields are divided by gullies that farm machinery cannot cross.

Loss of the surface layer through erosion and exposure of the lime substratum of the Ririe and similar soils reduce productivity. Part of the subsoil is incorporated in the plow layer when the surface layer is eroded. Sediment is deposited in streams as a result of some erosion on farmland. Control of erosion minimizes pollution of streams and improves the quality of water for municipal uses, recreation, and fish and wildlife.

Suitable practices to control erosion are those that provide a protective surface cover, reduce runoff, and increase infiltration. Using a cropping system that maintains a plant cover on the soil for extended periods reduces soil losses. Growing legumes and grasses reduces erosion, provides nitrogen, and improves tilth on soils used for pasture and hay. Minimizing tillage and leaving crop residue on the surface help to increase infiltration and reduce runoff and erosion.

Terraces and diversions reduce runoff and erosion by reducing the length of the slope. Deep, well drained soils that have regular slopes are best suited to these practices. Ririe and Tetonia soils are suited to terraces.

Soil blowing is a hazard on the Pancheri soils, especially if the winds are strong and the soils are dry and barren of vegetation and surface mulch. Proper tillage maintains needed plant cover and mulch on the rough surface of the soil. Windbreaks of adapted trees and shrubs, such as Russian-olive, Tatarian honeysuckle, and hybrid poplar, reduce the hazard of soil blowing.

Information on design of erosion control practices for each kind of soil is in the Technical Guide available in local offices of the Soil Conservation Service.

Soil fertility is relatively high in most soils in the survey area. All soils respond to nitrogen and phosphate. No significant areas are low in potash or trace elements. A high content of lime in some soils ties up the iron and causes chlorosis in some trees and shrubs. The local office of the Cooperative Extension Service can assist in determining the proper kinds and amounts of fertilizer to apply.

Soil tilth is an important factor in the germination of seeds and the infiltration of water into the soil. Soils that have good tilth are granular and porous. If the silt loams in Bonneville County Area are worked excessively, they become very powdery so that a good seedbed is difficult to establish. The soils on flood plains stay wet until late in spring. If these soils are plowed when wet, they tend to be very cloddy so that a good seedbed is difficult to prepare. Plowing in fall generally results in good tilth in spring.

Additional information and suggestions for growing special crops can be obtained from local offices of the Cooperative Extension Service and the Soil Conservation Service.

### **Yields per acre**

The average yields per acre that can be expected of the principal crops under a high level of management are shown in table 5. In any given year, yields may be higher or lower than those indicated in the table because of variations in rainfall and other climatic factors.

The yields are based mainly on the experience and records of farmers, conservationists, and extension agents. Available yield data from nearby counties and results of field trials and demonstrations are also considered.

The management needed to obtain the indicated yields of the various crops depends on the kind of soil and the crop. Management can include drainage, erosion control, and protection from flooding; the proper planting and seeding rates; suitable high-yielding crop varieties; appropriate and timely tillage; control of weeds, plant diseases, and harmful insects; favorable soil reaction and optimum levels of nitrogen, phosphorus, potassium,

and trace elements for each crop; effective use of crop residue, barnyard manure, and green-manure crops; and harvesting that insures the smallest possible loss.

For yields of irrigated crops, it is assumed that the irrigation system is adapted to the soils and to the crops grown, that good quality irrigation water is uniformly applied as needed, and that tillage is kept to a minimum.

The estimated yields reflect the productive capacity of each soil for each of the principal crops. Yields are likely to increase as new production technology is developed. The productivity of a given soil compared with that of other soils, however, is not likely to change.

### **Land capability classification**

Land capability classification shows, in a general way, the suitability of soils for most kinds of field crops. Crops that require special management are excluded. The soils are grouped according to their limitations for field crops, the risk of damage if they are used for crops, and the way they respond to management. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils, nor does it consider possible but unlikely major reclamation projects. Capability classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for rangeland, for woodland, and for engineering purposes.

In the capability system, soils are generally grouped at three levels: capability class, subclass, and unit (5). Only class and subclass are used in this survey. These levels are defined in the following paragraphs.

*Capability classes*, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use. The classes are defined as follows:

Class I soils have slight limitations that restrict their use.

Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.

Class III soils have severe limitations that reduce the choice of plants or that require special conservation practices, or both.

Class IV soils have very severe limitations that reduce the choice of plants or that require very careful management, or both.

Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use.

Class VI soils have severe limitations that make them generally unsuitable for cultivation.

Class VII soils have very severe limitations that make them unsuitable for cultivation.

Class VIII soils and miscellaneous areas have limitations that nearly preclude their use for commercial crop production.

*Capability subclasses* are soil groups within one class. They are designated by adding a small letter, *e*, *w*, *s*, or *c*, to the class numeral, for example, 11e. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is very cold or very dry.

In class I there are no subclasses because the soils of this class have few limitations. Class V contains only the subclasses indicated by *w*, *s*, or *c* because the soils in class V are subject to little or no erosion. They have other limitations that restrict their use to pasture, rangeland, woodland, wildlife habitat, or recreation.

The capability classification of each map unit is given in the section "Soil maps for detailed planning."

## Rangeland

By John Davis, range conservationist, Soil Conservation Service.

About 39 percent, or 234,000 acres, of Bonneville County Area is rangeland. Approximately 20 percent of the rangeland is privately owned, and the rest is administered by the Bureau of Land Management. Some of the rangeland is used by operators based outside of the county.

Commercial cow and calf operations are the main livestock enterprise in the survey area. Some areas are used for purebred cattle, dairy, and sheep operations. The forage is grazed in spring, in summer, and early in fall.

The basic soil and plant resources can best be maintained or improved through management. Among the important range management practices on all rangeland in the survey area are proper grazing use and planned grazing systems, which include deferred grazing and proper season of use in combination with good distribution of grazing. Distribution of grazing can be accomplished by properly locating watering facilities and by fencing where needed. The suitability of range improvement practices such as brush management, range seeding, and water developments depends on the characteristics of a given soil.

In areas that have similar climate and topography, differences in the kind and amount of vegetation produced on rangeland are closely related to the kind of soil. Effective management is based on the relationship between the soils and vegetation and water.

Table 6 shows, for each soil in the survey area, the range site; the total annual production of vegetation in favorable, normal, and unfavorable years; the characteristic vegetation; and the average percentage of each

species. Only those soils that are used as or are suited to rangeland are listed. Explanation of the column headings in table 6 follows.

A *range site* is a distinctive kind of rangeland that produces a characteristic natural plant community that differs from natural plant communities on other range sites in kind, amount, and proportion of range plants. The relationship between soils and vegetation was established during this survey; thus, range sites generally can be determined directly from the soil map. Soil properties that affect moisture supply and plant nutrients have the greatest influence on the productivity of range plants. Soil reaction, salt content, and a seasonal high water table are also important.

*Total production* is the amount of vegetation that can be expected to grow annually on well managed rangeland that is supporting the potential natural plant community. It includes all vegetation, whether or not it is palatable to grazing animals. It includes the current year's growth of leaves, twigs, and fruits of woody plants. It does not include the increase in stem diameter of trees and shrubs. It is expressed in pounds per acre of air-dry vegetation for favorable, normal, and unfavorable years. In a favorable year, the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average. In a normal year, growing conditions are about average. In an unfavorable year, growing conditions are well below average, generally because of low available soil moisture.

*Dry weight* is the total annual yield per acre reduced to a common percent of air-dry moisture.

*Characteristic vegetation*—the grasses, forbs, and shrubs that make up most of the potential natural plant community on each soil—is listed by common name. Under composition, the expected percentage of the total annual production is given for each species making up the characteristic vegetation. The amount that can be used as forage depends on the kinds of grazing animals and on the grazing season.

Range management requires a knowledge of the kinds of soil and of the potential natural plant community. It also requires an evaluation of the present range condition. Range condition is determined by comparing the present plant community with the potential natural plant community on a particular range site. The more closely the existing community resembles the potential community, the better the range condition. Range condition is an ecological rating only. It does not have a specific meaning that pertains to the present plant community in a given use.

The objective in range management is to control grazing so that the plants growing on a site are about the same in kind and amount as the potential natural plant community for that site. Such management generally results in the optimum production of vegetation, conservation of water, and control of erosion. Sometimes, however, a range condition somewhat below the potential

meets grazing needs, provides wildlife habitat, and protects soil and water resources.

## Windbreaks and environmental plantings

Windbreaks protect livestock, buildings, and yards from wind and snow. They also protect fruit trees and gardens, and they furnish habitat for wildlife. Several rows of low- and high-growing broadleaf and coniferous trees and shrubs provide the most protection.

Field windbreaks are narrow plantings made at right angles to the prevailing wind and at specific intervals across the field. The interval depends on the erodibility of the soil. Field windbreaks protect cropland and crops from wind, hold snow on the fields, and provide food and cover for wildlife.

Environmental plantings help to beautify and screen houses and other buildings and to abate noise. The plants, mostly evergreen shrubs and trees, are closely spaced. To insure plant survival, a healthy planting stock of suitable species should be planted properly on a well prepared site and maintained in good condition.

Table 7 shows the height that locally grown trees and shrubs are expected to reach in 20 years on various soils. The estimates in table 7 are based on measurements and observation of established plantings that have been given adequate care. They can be used as a guide in planning windbreaks and screens. Additional information on planning windbreaks and screens and planting and caring for trees and shrubs can be obtained from local offices of the Soil Conservation Service or the Cooperative Extension Service or from a nursery.

## Recreation

Most of Bonneville County Area, except the urban areas, is used for hunting game birds or animals. Trout is in the Snake River and its tributaries, and some areas are open to fishing the year around. Much of the survey area is suitable for sports such as horseback riding, cross-country skiing, and hiking. Water impoundments behind Palisade and Ririe Dams are suitable for fishing, boating, and water skiing. Swan Valley has good potential for summer homes because it is near Palisade Reservoir, it has cool summer temperatures, and it has a scenic setting.

The soils of the survey area are rated in table 8 according to limitations that affect their suitability for recreation. The ratings are based on restrictive soil features, such as wetness, slope, and texture of the surface layer. Susceptibility to flooding is considered. Not considered in the ratings, but important in evaluating a site, are the location and accessibility of the area, the size and shape of the area and its scenic quality, vegetation, access to water, potential water impoundment sites, and access to public sewerlines. The capacity of the soil to absorb septic tank effluent and the ability of the soil to support

vegetation are also important. Soils subject to flooding are limited for recreation use by the duration and intensity of flooding and the season when flooding occurs. In planning recreation facilities, onsite assessment of the height, duration, intensity, and frequency of flooding is essential.

In table 8, the degree of soil limitation is expressed as slight, moderate, or severe. *Slight* means that soil properties are generally favorable and that limitations are minor and easily overcome. *Moderate* means that limitations can be overcome or alleviated by planning, design, or special maintenance. *Severe* means that soil properties are unfavorable and that limitations can be offset only by costly soil reclamation, special design, intensive maintenance, limited use, or by a combination of these measures.

The information in table 8 can be supplemented by other information in this survey, for example, interpretations for septic tank absorption fields in table 11 and interpretations for dwellings without basements and for local roads and streets in table 10.

*Camp areas* require site preparation such as shaping and leveling the tent and parking areas, stabilizing roads and intensively used areas, and installing sanitary facilities and utility lines. Camp areas are subject to heavy foot traffic and some vehicular traffic. The best soils have mild slopes and are not wet or subject to flooding during the period of use. The surface has few or no stones or boulders, absorbs rainfall readily but remains firm, and is not dusty when dry. Strong slopes and stones or boulders can greatly increase the cost of constructing campsites.

*Picnic areas* are subject to heavy foot traffic. Most vehicular traffic is confined to access roads and parking areas. The best soils for picnic areas are firm when wet, are not dusty when dry, are not subject to flooding during the period of use, and do not have slopes or stones or boulders that increase the cost of shaping sites or of building access roads and parking areas.

*Playgrounds* require soils that can withstand intensive foot traffic. The best soils are almost level and are not wet or subject to flooding during the season of use. The surface is free of stones and boulders, is firm after rains, and is not dusty when dry. If grading is needed, the depth of the soil over bedrock or a hardpan should be considered.

*Paths and trails* for hiking, horseback riding, and bicycling should require little or no cutting and filling. The best soils are not wet, are firm after rains, are not dusty when dry, and are not subject to flooding more than once a year during the period of use. They have moderate slopes and few or no stones or boulders on the surface.



## Wildlife habitat

Bonneville County Area has a wide variety of game animals. Deer, moose, elk, and black bear inhabit the mountainous areas in the eastern part of the area and in the canyons that cut the dryfarmed foothills. Pronghorn antelope, coyote, jackrabbit, and cottontail inhabit the sagebrush-covered plains in the western part of the area. Irrigated farmland is suited to ring-necked pheasant. Chukar, Hungarian partridge, sharp-tailed grouse, and sage grouse use the rangeland, and blue grouse and ruffed grouse use the forest land. Mourning doves adapt to many habitats and commonly nest in urban areas. The survey area is suitable for birds of prey, including golden eagle.

Soils affect the kind and amount of vegetation that is available to wildlife as food and cover. They also affect the construction of water impoundments. The kind and abundance of wildlife depend largely on the amount and distribution of food, cover, and water. Wildlife habitat can be created or improved by planting appropriate vegetation, by maintaining the existing plant cover, or by promoting the natural establishment of desirable plants.

In table 9, the soils in the survey area are rated according to their potential for providing habitat for various kinds of wildlife. This information can be used in planning parks, wildlife refuges, nature study areas, and other developments for wildlife; in selecting soils that are suitable for establishing, improving, or maintaining specific elements of wildlife habitat; and in determining the intensity of management needed for each element of the habitat.

The potential of the soil is rated good, fair, poor, or very poor. A rating of *good* indicates that the element or kind of habitat is easily established, improved, or maintained. Few or no limitations affect management, and satisfactory results can be expected. A rating of *fair* indicates that the element or kind of habitat can be established, improved, or maintained in most places. Moderately intensive management is required for satisfactory results. A rating of *poor* indicates that limitations are severe for the designated element or kind of habitat. Habitat can be created, improved, or maintained in most places, but management is difficult and must be intensive. A rating of *very poor* indicates that restrictions for the element or kind of habitat are very severe and that unsatisfactory results can be expected. Creating, improving, or maintaining habitat is impractical or impossible.

The elements of wildlife habitat are described in the following paragraphs.

*Grain and seed crops* are domestic grains and seed-producing herbaceous plants. Soil properties and features that affect the growth of grain and seed crops are depth of the root zone, texture of the surface layer, available water capacity, wetness, slope, surface stoniness, and flood hazard. Soil temperature and soil mois-

ture are also considerations. Examples of grain and seed crops are wheat, oats, and barley.

*Grasses and legumes* are domestic perennial grasses and herbaceous legumes. Soil properties and features that affect the growth of grasses and legumes are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, flood hazard, and slope. Soil temperature and soil moisture are also considerations. Examples of grasses and legumes are fescue, brome grass, clover, and alfalfa.

*Wild herbaceous plants* are native or naturally established grasses and forbs, including weeds. Soil properties and features that affect the growth of these plants are depth of the root zone, texture of the surface layer, available water capacity, wetness, surface stoniness, and flood hazard. Soil temperature and soil moisture are also considerations. Examples of wild herbaceous plants are goldenrod, beggarweed, wheatgrass, and bromes.

*Coniferous plants* furnish browse, seeds, and cones. Soil properties and features that affect the growth of coniferous trees, shrubs, and ground cover are depth of the root zone, available water capacity, and wetness. Examples of coniferous plants are pine, spruce, fir, cedar, and juniper.

*Shrubs* are bushy woody plants that produce fruit, buds, twigs, bark, and foliage. Soil properties and features that affect the growth of shrubs are depth of the root zone, available water capacity, salinity, and soil moisture. Examples of shrubs are mountain mahogany, bitterbrush, snowberry, and big sagebrush.

*Wetland plants* are annual and perennial wild herbaceous plants that grow on moist or wet sites. Submerged or floating aquatic plants are excluded. Soil properties and features affecting wetland plants are texture of the surface layer, wetness, reaction, salinity, slope, and surface stoniness. Examples of wetland plants are smartweed, wild millet, saltgrass, cordgrass, rushes, sedges, and reeds.

*Shallow water areas* have an average depth of less than 5 feet. Some are naturally wet areas. Others are created by dams, levees, or other water-control structures. Soil properties and features affecting shallow water areas are depth to bedrock, wetness, surface stoniness, slope, and permeability. Examples of shallow water areas are marshes, waterfowl feeding areas, and ponds.

The habitat for various kinds of wildlife is described in the following paragraphs.

*Habitat for openland wildlife* consists of cropland, pasture, meadows, and areas that are overgrown with grasses, herbs, shrubs, and vines. These areas produce grain and seed crops, grasses and legumes, and wild herbaceous plants. The wildlife attracted to these areas include quail, pheasant, meadowlark, field sparrow, cottontail, and red fox.

*Habitat for woodland wildlife* consists of areas of deciduous plants or coniferous plants, or both, and associ-

ated grasses, legumes, and wild herbaceous plants. Wildlife attracted to these areas include ruffed grouse, thrushes, woodpeckers, squirrels, raccoon, deer, and bear.

*Habitat for wetland wildlife* consists of open, marshy or swampy shallow water areas. Some of the wildlife attracted to such areas are ducks, geese, herons, shore birds, muskrat, mink, and beaver.

*Habitat for rangeland wildlife* consists of areas of shrubs and wild herbaceous plants. Wildlife attracted to rangeland include antelope, deer, sage grouse, meadowlark, and lark bunting.

## Engineering

This section provides information for planning land uses related to urban development and to water management. Soils are rated for various uses, and the most limiting features are identified. The ratings are given in the following tables: Building site development, Sanitary facilities, Construction materials, and Water management. The ratings are based on observed performance of the soils and on the estimated data and test data in the "Soil properties" section.

*Information in this section is intended for land use planning, for evaluating land use alternatives, and for planning site investigations prior to design and construction. The information, however, has limitations. For example, estimates and other data generally apply only to that part of the soil within a depth of 5 or 6 feet. Because of the map scale, small areas of different soils may be included within the mapped areas of a specific soil.*

*The information is not site specific and does not eliminate the need for onsite investigation of the soils or for testing and analysis by personnel experienced in the design and construction of engineering works.*

Government ordinances and regulations that restrict certain land uses or impose specific design criteria were not considered in preparing the information in this section. Local ordinances and regulations need to be considered in planning, in site selection, and in design.

Soil properties, site features, and- observed performance were considered in determining the ratings in this section. During the fieldwork for this soil survey, determinations were made about grain-size distribution, liquid limit, plasticity index, soil reaction, depth to bedrock, hardness of bedrock within 5 to 6 feet of the surface, soil wetness, depth to a seasonal high water table, slope, likelihood of flooding, natural soil structure aggregation, and soil density. Data were collected about kinds of clay minerals, mineralogy of the sand and silt fractions, and the kind of adsorbed cations. Estimates were made for erodibility, permeability, corrosivity, shrink-swell potential, available water capacity, and other behavioral characteristics affecting engineering uses.

This information can be used to (1) evaluate the potential of areas for residential, commercial, industrial, and recreation uses; (2) make preliminary estimates of construction conditions; (3) evaluate alternative routes for roads, streets, highways, pipelines, and underground cables; (4) evaluate alternative sites for sanitary landfills, septic tank absorption fields, and sewage lagoons; (5) plan detailed onsite investigations of soils and geology; (6) locate potential sources of gravel, sand, earthfill, and topsoil; (7) plan drainage systems, irrigation systems, ponds, terraces, and other structures for soil and water conservation; and (8) predict performance of proposed small structures and pavements by comparing the performance of existing similar structures on the same or similar soils.

The information in the tables, along with the soil maps, the soil descriptions, and other data provided in this survey can be used to make additional interpretations.

Some of the terms used in this soil survey have a special meaning in soil science and are defined in the Glossary.

### Building site development

Table 10 shows the degree and kind of soil limitations that affect shallow excavations, dwellings with and without basements, small commercial buildings, and local roads and streets. The limitations are considered *slight* if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required. Special feasibility studies may be required where the soil limitations are severe.

Shallow excavations are trenches or holes dug to a maximum depth of 5 or 6 feet for basements, graves, utility lines, open ditches, and other purposes. The ratings are based on soil properties, site features, and observed performance of the soils. The ease of digging, filling, and compacting is affected by the depth to bedrock, a cemented pan, or a very firm dense layer; stone content; soil texture; and slope. The time of the year that excavations can be made is affected by the depth to a seasonal high water table and the susceptibility of the soil to flooding. The resistance of the excavation walls or banks to sloughing or caving is affected by soil texture and the depth to the water table.

*Dwellings and small commercial buildings* are structures built on shallow foundations on undisturbed soil. The load limit is the same as that for single-family dwellings no higher than three stories. Ratings are made for small commercial buildings without basements, for dwell-

ings with basements, and for dwellings without basements. The ratings are based on soil properties, site features, and observed performance of the soils. A high water table, flooding, shrink-swell potential, and organic layers can cause the movement of footings. A high water table, depth to bedrock or to a cemented pan, large stones, and flooding affect the ease of excavation and construction. Landscaping and grading that require cuts and fills of more than 5 to 6 feet are not considered.

*Local roads and streets* have an all-weather surface and carry automobile and light truck traffic all year. They have a subgrade of cut or fill soil material, a base of gravel, crushed rock, or stabilized soil material, and a flexible or rigid surface. Cuts and fills are generally limited to less than 6 feet. The ratings are based on soil properties, site features, and observed performance of the soils. Depth to bedrock or to a cemented pan, a high water table, flooding, large stones, and slope affect the ease of excavating and grading. Soil strength (as inferred from the engineering classification of the soil), shrink-swell potential, frost action potential, and depth to a high water table affect the traffic supporting capacity.

## Sanitary facilities

Table 11 shows the degree and the kind of soil limitations that affect septic tank absorption fields, sewage lagoons, and sanitary landfills. The limitations are considered slight if soil properties and site features are generally favorable for the indicated use and limitations are minor and easily overcome; *moderate* if soil properties or site features are not favorable for the indicated use and special planning, design, or maintenance is needed to overcome or minimize the limitations; and *severe* if soil properties or site features are so unfavorable or so difficult to overcome that special design, significant increases in construction costs, and possibly increased maintenance are required.

Table 11 also shows the suitability of the soils for use as daily cover for landfills. A rating of *good* indicates that soil properties and site features are favorable for the use and good performance and low maintenance can be expected; *fair* indicates that soil properties and site features are moderately favorable for the use and one or more soil properties or site features make the soil less desirable than the soils rated good; and *poor* indicates that one or more soil properties or one or more site features are unfavorable for the use and overcoming the unfavorable properties requires special design, extra maintenance, or costly alteration.

*Septic tank absorption fields* are areas in which effluent from a septic tank is distributed into the soil through subsurface tiles or perforated pipe. Only that part of the soil between depths of 24 and 72 inches is evaluated. The ratings are based on soil properties, site features, and observed performance of the soils. Permeability, a high water table, depth to bedrock or to a cemented

pan, and flooding affect absorption of the effluent. Large stones and bedrock or a cemented pan interfere with installation.

Unsatisfactory performance of septic tank absorption fields, including excessively slow absorption of effluent, surfacing of effluent, and hillside seepage, can affect public health. Ground water can be polluted if highly permeable sand and gravel or fractured bedrock is less than 4 feet below the base of the absorption field, if slope is excessive, or if the water table is near the surface. There must be unsaturated soil material beneath the absorption field to effectively filter the effluent. Many local ordinances require that this material be of a certain thickness.

*Sewage lagoons* are shallow ponds constructed to hold sewage while aerobic bacteria decompose the solid and liquid wastes. Lagoons should have a nearly level floor surrounded by cut slopes or embankments of compacted soil. Lagoons generally are designed to hold the sewage within a depth of 2 to 5 feet. Nearly impervious soil material for the lagoon floor and sides is required to minimize seepage and contamination of ground water.

Table 11 gives ratings for the natural soil that makes up the lagoon floor. The surface layer and, generally, 1 or 2 feet of soil material below the surface layer are excavated to provide material for the embankments. The ratings are based on soil properties, site features, and observed performance of the soils. Considered in the ratings are slope, permeability, a high water table, depth to bedrock or to a cemented pan, flooding, large stones, and content of organic matter.

Excessive seepage due to rapid permeability of the soil or a water table that is high enough to raise the level of sewage in the lagoon causes a lagoon to function unsatisfactorily. Pollution results if seepage is excessive or if floodwater overtops the lagoon. A high content of organic matter is detrimental to proper functioning of the lagoon because it inhibits aerobic activity. Slope, bedrock, and cemented pans can cause construction problems, and large stones can hinder compaction of the lagoon floor.

*Sanitary landfills* are areas where solid waste is disposed of by burying it in soil. There are two types of landfill—trench and area. In a trench landfill, the waste is placed in a trench. It is spread, compacted, and covered daily with a thin layer of soil excavated at the site. In an area landfill, the waste is placed in successive layers on the surface of the soil. The waste is spread, compacted, and covered daily with a thin layer of soil from a source away from the site.

Both types of landfill must be able to bear heavy vehicular traffic. Both types involve a risk of ground water pollution. Ease of excavation and revegetation needs to be considered.

The ratings in table 11 are based on soil properties, site features, and observed performance of the soils. Permeability, depth to bedrock or to a cemented pan, a

high water table, slope, and flooding affect both types of landfill. Texture, stones and boulders, highly organic layers, soil reaction, and content of salts and sodium affect trench type landfills. Unless otherwise stated, the ratings apply only to that part of the soil within a depth of about 6 feet. For deeper trenches, a limitation rated slight or moderate may not be valid. Onsite investigation is needed.

*Daily cover for landfill* is the soil material that is used to cover compacted solid waste in an area type sanitary landfill. The soil material is obtained offsite, transported to the landfill, and spread over the waste.

Soil texture, wetness, coarse fragments, and slope affect the ease of removing and spreading the material during wet and dry periods. Loamy or silty soils that are free of large stones or excess gravel are the best cover for a landfill. Clayey soils are sticky or cloddy and are difficult to spread; sandy soils are subject to soil blowing.

After soil material has been removed, the soil material remaining in the borrow area must be thick enough over bedrock, a cemented pan, or the water table to permit revegetation. The soil material used as final cover for a landfill should be suitable for plants. The surface layer generally has the best workability, more organic matter, and the best potential for plants. Material from the surface layer should be stockpiled for use as the final cover.

## Construction materials

The suitability of each soil as a source of roadfill, sand, gravel, and topsoil is indicated in table 12 by ratings of good, fair, or poor. The texture, thickness, and organic-matter content of each soil horizon are important factors in rating soils for use as construction materials. Each soil is evaluated to the depth observed, generally about 6 feet.

*Roadfill* is soil material used in embankments for roads. Soils are evaluated as a source of roadfill for low embankments, which generally are less than 6 feet high and less exacting in design than high embankments. The ratings reflect the ease of excavating and working the material and the expected performance of the material where it has been compacted and adequately drained. The performance of soil after it is stabilized with lime or cement is not considered in the ratings, but information about some of the soil properties that influence such performance is given in the descriptions of the soil series.

The ratings apply to the soil material between the A horizon and a depth of 5 to 6 feet. It is assumed that soil horizons will be mixed during excavation and spreading. Many soils have horizons of contrasting suitability within their profile. The estimated engineering properties in table 14 provide specific information about the nature of each horizon. This information can help determine the suitability of each horizon for roadfill.

Soils rated *good* are coarse grained. They have low shrink-swell potential, low potential frost action, and few cobbles and stones. They are at least moderately well drained and have slopes of 15 percent or less. Soils rated *fair* have a plasticity index of less than 15 and have other limiting features, such as moderate shrink-swell potential, moderately steep slopes, wetness, or many stones. If the thickness of suitable material is less than 3 feet, the entire soil is rated poor.

*Sand and gravel* are used in great quantities in many kinds of construction. The ratings in table 12 provide guidance as to where to look for probable sources and are based on the probability that soils in a given area contain sizable quantities of sand or gravel. A soil rated good or fair has a layer of suitable material at least 3 feet thick, the top of which is within a depth of 6 feet. Coarse fragments of soft bedrock material, such as shale and siltstone, are not considered to be sand and gravel. Fine-grained soils are not suitable sources of sand and gravel.

The ratings do not take into account depth to the water table or other factors that affect excavation of the material. Descriptions of grain size, kinds of minerals, reaction, and stratification are given in the soil series descriptions and in table 14.

*Topsoil* is used in areas where vegetation is to be established and maintained. Suitability is affected mainly by the ease of working and spreading the soil material in preparing a seedbed and by the ability of the soil material to support plantlife. Also considered is the damage that can result at the area from which the topsoil is taken.

The ease of excavation is influenced by the thickness of suitable material, wetness, slope, and amount of stones. The ability of the soil to support plantlife is determined by texture, structure, and the amount of soluble salts or toxic substances. Organic matter in the A1 or Ap horizon greatly increases the absorption and retention of moisture and nutrients. Therefore, the soil material from these horizons should be carefully preserved for later use.

Soils rated good have at least 16 inches of friable loamy material at their surface. They are free of stones and cobbles, are low in content of gravel, and have gentle slopes. They are low in soluble salts that can limit or prevent plant growth. They are naturally fertile or respond well to fertilizer. They are not so wet that excavation is difficult during most of the year.

Soils rated fair are loose sandy soils or firm loamy or clayey soils in which the suitable material is only 8 to 16 inches thick or soils that have appreciable amounts of gravel, stones, or soluble salt.

Soils rated poor are very sandy soils and very firm clayey soils; soils with suitable layers less than 8 inches thick; soils having large amounts of gravel, stones, or soluble salt; steep soils; and poorly drained soils.

Although a rating of *good* is not based entirely on high content of organic matter, a surface horizon is generally preferred for topsoil because of its organic-matter content. This horizon is designated as A1 or Ap in the soil series descriptions. The absorption and retention of moisture and nutrients for plant growth are greatly increased by organic matter.

## Water management

Many soil properties and site features that affect water management practices have been identified in this soil survey. In table 13 soil and site features that affect use are indicated for each kind of soil. This information is significant in planning, installing, and maintaining water control structures.

*Pond reservoir areas* hold water behind a dam or embankment. Soils best suited to this use have a low seepage potential, which is determined by permeability and the depth to fractured or permeable bedrock or other permeable material.

*Embankments, dikes, and levees* require soil material that is resistant to seepage, erosion, and piping and has favorable stability, shrink-swell potential, shear strength, and compaction characteristics. Large stones and organic matter in a soil downgrade the suitability of a soil for use in embankments, dikes, and levees.

*Aquifer-fed excavated ponds* are bodies of water made by excavating a pit or dugout into a ground-water aquifer. Excluded are ponds that are fed by surface runoff and embankment ponds that impound water 3 feet or more above the original surface. Ratings in table 13 are for ponds that are properly designed, located, and constructed. Soil properties and site features that affect aquifer-fed ponds are depth to a permanent water table, permeability of the aquifer, quality of the water, and ease of excavation.

*Drainage* of soil is affected by such soil properties as permeability; texture; depth to bedrock, hardpan, or other layers that affect the rate of water movement; depth to the water table; slope; stability of ditchbanks; susceptibility to flooding; salinity and alkalinity; and availability of outlets for drainage.

*Irrigation* is affected by such features as slope, susceptibility to flooding, hazards of water erosion and soil blowing, texture, presence of salts and alkali, depth of root zone, rate of water intake at the surface, permeability of the soil below the surface layer, available water capacity, need for drainage, and depth to the water table.

*Terraces and diversions* are embankments or a combination of channels and ridges constructed across a slope to intercept runoff. They allow water to soak into the soil or flow slowly to an outlet. Features that affect suitability of a soil for terraces are uniformity and steepness of slope; depth to bedrock, hardpan, or other unfavorable material; large stones; permeability; ease of es-

tablishing vegetation; and resistance to water erosion, soil blowing, soil slipping, and piping.

*Grassed waterways* are constructed to channel runoff to outlets at a nonerosive velocity. Features that affect the use of soils for waterways are slope, permeability, erodibility, wetness, and suitability for permanent vegetation.

## Soil properties

Data relating to soil properties are collected during the course of the soil survey. The data and the estimates of soil and water features, listed in tables, are explained on the following pages.

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. Established standard procedures are followed. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics.

Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas. Tests verify field observations, verify properties that cannot be estimated accurately by field observation, and help characterize key soils.

The estimates of soil properties shown in the tables include the range of grain-size distribution and Atterberg limits, the engineering classifications, and the physical and chemical properties of the major layers of each soil. Pertinent soil and water features also are given.

## Engineering index properties

Table 14 gives estimates of engineering properties and classifications for the major horizons of each soil in the survey area (3).

Most soils have, within the upper 5 or 6 feet, horizons of contrasting properties. Table 14 gives information for each of these contrasting horizons in a typical profile. *Depth* to the upper and lower boundaries of each horizon is indicated. More information about the range in depth and about other properties in each horizon is given for each soil series in the section "Soil series and morphology."

Texture is described in table 14 in the standard terms used by the U.S. Department of Agriculture. These terms are defined according to percentages of sand, silt, and clay in soil material that is less than 2 millimeters in diameter. "Loam," for example, is soil material that is 7 to 27 percent clay, 28 to 50 percent silt, and less than 52 percent sand. If a soil contains gravel or other particles coarser than sand, an appropriate modifier is added,

for example, "gravelly loam." Other texture terms are defined in the Glossary.

The two systems commonly used in classifying soils for engineering use are the Unified Soil Classification System (Unified) (2) and the system adopted by the American Association of State Highway and Transportation Officials (AASHTO) (1).

The *Unified* system classifies soils according to properties that affect their use as construction material. Soils are classified according to grain-size distribution of the fraction less than 3 inches in diameter, plasticity index, liquid limit, and organic-matter content. Soils are grouped into 15 classes—eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes have a dual classification symbol, for example, CL-ML.

The *AASHTO* system classifies soils according to those properties that affect their use in highway construction and maintenance. In this system a mineral soil is classified in one of seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. Soils in group A-1 are coarse grained and low in content of fines. At the other extreme, in group A-7, are fine-grained soils. Highly organic soils are classified in group A-8 on the basis of visual inspection.

The estimated classification, without group index numbers, is given in table 14. Also in table 14 the percentage, by weight, of rock fragments more than 3 inches in diameter is estimated for each major horizon. These estimates are determined mainly by observing volume percentage in the field and then converting that, by formula, to weight percentage.

Percentage of the soil material less than 3 inches in diameter that passes each of four sieves (U.S. standard) is estimated for each major horizon. The estimates are based on tests of soils that were sampled in the survey area and in nearby areas and on field estimates from many borings made during the survey.

*Liquid limit* and *plasticity index* indicate the effect of water on the strength and consistence of soil. These indexes are used in both the Unified and AASHTO soil classification systems. They are also used as indicators in making general predictions of soil behavior. Range in liquid limit and plasticity index are estimated on the basis of test data from the survey area or from nearby areas and on observations of the many soil borings made during the survey.

In some surveys, the estimates are rounded to the nearest 5 percent. Thus, if the ranges of gradation and Atterberg limits extend a marginal amount across classification boundaries (1 or 2 percent), the classification in the marginal zone is omitted.

## Physical and chemical properties

Table 15 shows estimates of some characteristics and features that affect soil behavior. These estimates are given for the major layers of each soil in the survey area. The estimates are based on field observations and on test data for these and similar soils.

*Permeability* refers to the ability of a soil to transmit water or air. The estimates indicate the rate of downward movement of water when the soil is saturated. They are based on soil characteristics observed in the field, particularly structure, porosity, and texture. Permeability is considered in the design of soil drainage systems, septic tank absorption fields, and construction where the rate of water movement under saturated conditions affects behavior.

*Available water capacity* refers to the quantity of water that the soil is capable of storing for use by plants. The capacity for water storage is given in inches of water per inch of soil for each major soil layer. The capacity varies, depending on soil properties that affect the retention of water and the depth of the root zone. The most important properties are the content of organic matter, soil texture, bulk density, and soil structure. Available water capacity is an important factor in the choice of plants or crops to be grown and in the design and management of irrigation systems. Available water capacity is not an estimate of the quantity of water actually available to plants at any given time.

*Soil reaction* is a measure of acidity or alkalinity and is expressed as a range in pH values. The range in pH of each major horizon is based on many field tests. For many soils, values have been verified by laboratory analyses. Soil reaction is important in selecting crops and other plants, in evaluating soil amendments for fertility and stabilization, and in determining the risk of corrosion.

*Salinity* is a measure of soluble salts in the soil at saturation. It is expressed as the electrical conductivity of the saturation extract, in millimhos per centimeter at 25 degrees C. Estimates are based on field and laboratory measurements at representative sites of nonirrigated soils. The salinity of irrigated soils is affected by the quality of the irrigation water and by the frequency of water application. Hence, the salinity of soils in individual fields can differ greatly from the value given in the table. Salinity affects the suitability of a soil for crop production, the stability of soil if used as construction material, and the potential of the soil to corrode metal and concrete.

*Shrink-swell potential* is the potential for volume change in a soil with a loss or gain in moisture. Volume change occurs mainly because of the interaction of clay minerals with water and varies with the amount and type of clay minerals in the soil. The size of the load on the soil and the magnitude of the change in soil moisture content influence the amount of swelling of soils in place. Laboratory measurements of swelling of undisturbed clods were made for many soils. For others,

swelling was estimated on the basis of the kind and amount of clay minerals in the soil and on measurements of similar soils.

If the shrink-swell potential is rated moderate to very high, shrinking and swelling can cause damage to buildings, roads, and other structures. Special design is often needed.

Shrink-swell potential classes are based on the change in length of an unconfined clod as moisture content is increased from air-dry to field capacity. The change is based on the soil fraction less than 2 millimeters in diameter. The classes are *low*, a change of less than 3 percent; *moderate*, 3 to 6 percent; and *high*, more than 6 percent. *Very high*, greater than 9 percent, is sometimes used.

*Erosion factor K* indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter (up to 4 percent) and on soil structure and permeability. Values of K range from 0.05 to 0.69. The higher the value the more susceptible the soil is to sheet and rill erosion by water.

*Erosion factor T* is an estimate of the maximum average annual rate of soil erosion by wind or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

*Wind erodibility groups* are made up of soils that have similar properties affecting their resistance to wind erosion in cultivated areas. The groups indicate the susceptibility of soil to wind erosion and the amount of soil lost. Soils are grouped according to the following distinctions:

1. Sands, coarse sands, fine sands, and very fine sands. These soils are generally not suitable for crops. They are extremely erodible, and vegetation is difficult to establish.

2. Loamy sands, loamy fine sands, and loamy very fine sands. These soils are very highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

3. Sandy loams, coarse sandy loams, fine sandy loams, and very fine sandy loams. These soils are highly erodible. Crops can be grown if intensive measures to control wind erosion are used.

4L. Calcareous loamy soils that are less than 35 percent clay and more than 5 percent finely divided calcium carbonate. These soils are erodible. Crops can be grown if intensive measures to control wind erosion are used.

4. Clays, silty clays, clay loams, and silty clay loams that are more than 35 percent clay. These soils are moderately erodible. Crops can be grown if measures to control wind erosion are used.

5. Loamy soils that are less than 18 percent clay and less than 5 percent finely divided calcium carbonate and sandy clay loams and sandy clays that are less than 5

percent finely divided calcium carbonate. These soils are slightly erodible. Crops can be grown if measures to control wind erosion are used.

6. Loamy soils that are 18 to 35 percent clay and less than 5 percent finely divided calcium carbonate, except silty clay loams. These soils are very slightly erodible. Crops can easily be grown.

7. Silty clay loams that are less than 35 percent clay and less than 5 percent finely divided calcium carbonate. These soils are very slightly erodible. Crops can easily be grown.

8. Stony or gravelly soils and other soils not subject to wind erosion.

Organic matter is the plant and animal residue in the soil at various stages of decomposition.

In table 15, the estimated content of organic matter of the plow layer is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter.

The content of organic matter of a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

## Soil and water features

Table 16 contains information helpful in planning land uses and engineering projects that are likely to be affected by soil and water features.

Hydrologic soil groups are used to estimate runoff from precipitation. Soils not protected by vegetation are placed in one of four groups on the basis of the intake of water after the soils have been wetted and have received precipitation from long-duration storms.

The four hydrologic soil groups are:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist chiefly of deep, well drained to excessively drained sands or gravels. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils that have a layer that impedes the downward movement of water or soils that have moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clay soils that have a high shrink-swell potential, soils that have a permanent high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious materi-

al. These soils have a very slow rate of water transmission.

*Flooding* is the temporary covering of soil with water from overflowing streams, with runoff from adjacent slopes, and by tides. Water standing for short periods after rains or after snow melts is not considered flooding, nor is water in swamps and marshes. Flooding is rated in general terms that describe the frequency of flooding. The ratings are based on evidence in the soil profile of the effects of flooding, namely thin strata of gravel, sand, silt, or, in places, clay deposited by floodwater; irregular decrease in organic-matter content with increasing depth; and absence of distinctive soil horizons that form in soils of the area that are not subject to flooding. The ratings are also based on local information about flood-water levels in the area and the extent of flooding and on information that relates the position of each soil on the landscape to historic floods.

The generalized description of flood hazards is of value in land-use planning and provides a valid basis for land-use restrictions. The soil data are less specific, however, than those provided by detailed engineering surveys that delineate flood-prone areas at specific flood frequency levels.

*Depth* to bedrock is shown for all soils that are underlain by bedrock at a depth of 5 to 6 feet or less. For many soils, the limited depth to bedrock is a part of the definition of the soil series. The depths shown are based on measurements made in many soil borings and on other observations during the mapping of the soils. The kind of bedrock and its hardness as related to ease of excavation is also shown. Rippable bedrock can be excavated with a single-tooth ripping attachment on a 200-horsepower tractor, but hard bedrock generally requires blasting.

*Potential frost action* refers to the likelihood of damage to pavements and other structures by frost heaving and low soil strength after thawing. Frost action results from the movement of soil moisture into the freezing temperature zone in the soil, which causes ice lenses to form. Soil texture, temperature, moisture content, porosity, permeability, and content of organic matter are the most important soil properties that affect frost action. It is assumed that the soil is not covered by insulating vegetation or snow and is not artificially drained. Silty and clayey soils that have a high water table in winter are most susceptible to frost action. Well drained very gravelly or sandy soils are the least susceptible.

*Risk of corrosion* pertains to potential soil-induced chemical action that dissolves or weakens uncoated steel or concrete. The rate of corrosion of uncoated steel is related to soil moisture, particle-size distribution, total acidity, and electrical conductivity of the soil. The rate of corrosion of concrete is based mainly on the sulfate content, texture, and acidity of the soil. Protection of steel or more resistant concrete minimizes damage. Uncoated

steel intersecting soil boundaries or soil horizons is more susceptible to corrosion than an installation that is entirely within one kind of soil or within one soil horizon.

## Classification of the soils

The system of soil classification used by the National Cooperative Soil Survey has six categories (9). Beginning with the broadest, these categories are the order, suborder, great group, subgroup, family, and series. Classification is based on soil properties observed in the field or inferred from those observations or from laboratory measurements. In table 17, the soils of the survey area are classified according to the system. The categories are defined in the following paragraphs.

**ORDER.** Ten soil orders are recognized. The differences among orders reflect the dominant soil-forming processes and the degree of soil formation. Each order is identified by a word ending in *sol*. An example is Entisol.

**SUBORDER.** Each order is divided into suborders primarily on the basis of properties that influence soil genesis and are important to plant growth or properties that reflect the most important variables within the orders. The last syllable in the name of a suborder indicates the order. An example is Xeroll (*Xer*, meaning dry, plus *oll*, from Mollisol).

**GREAT GROUP.** Each suborder is divided into great groups on the basis of close similarities in kind, arrangement, and degree of development of pedogenic horizons; soil moisture and temperature regimes; and base status. Each great group is identified by the name of a suborder and by a prefix that indicates a property of the soil. An example is Haploxerolls (*Haplo*, meaning minimal horizonation, plus *xeroll*, the suborder of the Mollisols that have moist winters and dry summers).

**SUBGROUP.** Each great group has a typic subgroup. Other subgroups are intergrades or extragrades. The typic is the central concept of the great group; it is not necessarily the most extensive. Intergrades are transitions to other orders, suborders, or great groups. Extragrades have some properties that are not representative of the great group but do not indicate transitions to any other known kind of soil. Each subgroup is identified by one or more adjectives preceding the name of the great group. The adjective Typic identifies the subgroup that typifies the great group. An example is Typic Haploxerolls.

**FAMILY.** Families are established within a subgroup on the basis of physical and chemical properties and other characteristics that affect management. Mostly the properties are those of horizons below plow depth where there is much biological activity. Among the properties and characteristics considered are particle-size class, mineral content, temperature regime, depth of the root



zone, consistence, moisture equivalent, slope, and permanent cracks. A family name consists of the name of a subgroup preceded by terms that indicate soil properties. An example is fine-loamy, mixed, frigid Typic Haploxerolls.

**SERIES.** The series consists of soils that have similar horizons in their profile. The horizons are similar in color, texture, structure, reaction, consistence, mineral and chemical composition, and arrangement in the profile. The texture of the surface layer or of the substratum can differ within a series.

## Soil series and morphology

In this section, each soil series recognized in the survey area is described. The descriptions are arranged in alphabetic order.

Characteristics of the soil and the material in which it formed are identified for each series. The soil is compared with similar soils and with nearby soils of other series. A pedon, a small three-dimensional area of soil, that is typical of the series in the survey area is described. The detailed description of each soil horizon follows standards in the Soil Survey Manual (4). Many of the technical terms used in the descriptions are defined in Soil Taxonomy (6). Unless otherwise stated, colors in the descriptions are for moist soil. Following the pedon description is the range of important characteristics of the soils in the series.

The map units of each soil series are described in the section "Soil maps for detailed planning."

### Ammon series

The Ammon series consists of very deep, well drained soils on alluvial fans and foot slopes. These soils formed in alluvium derived dominantly from loess. Slope is 0 to 4 percent. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free season is 95 to 125 days.

Ammon soils are near Bock, Paul, and Potell soils. Bock soils have a coarse-loamy control section. Paul soils have a fine-loamy control section. Potell soils do not have a mollic epipedon.

Typical pedon of Ammon silt loam, 0 to 2 percent slopes, 800 feet south and 250 feet west of the northeast corner of sec. 22, T. 1 N., R. 38 E.

A11-0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; few fine interstitial pores; slightly calcareous; mildly alkaline (pH 7.6); clear smooth boundary.

A12-5 to 15 inches; brown (10YR 5/3) silt loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores; moderately calcareous; moderately alkaline (pH 8.0); clear smooth boundary.

C1-15 to 40 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak coarse and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine and fine tubular pores; many krotovinas with weak lime coatings on outsides; moderately calcareous; moderately alkaline (pH 8.0); gradual smooth boundary.

C2-40 to 60 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; common very fine and fine tubular pores; few krotovinas with weak lime coatings on outsides; moderately calcareous; moderately alkaline (pH 8.2).

The 10- to 40-inch control section is dominantly silt loam and averages 10 to 14 percent clay. The mollic epipedon is 10 to 15 inches thick. It is mildly alkaline to moderately alkaline. The Ap or A1 horizon has chroma of 2 or 3. The C horizon has value of 5 to 7 when dry and 3 to 5 when moist, and it has chroma of 2 or 3.

### Araveton series

The Araveton series consists of very deep, well drained soils on foothills. These soils formed in loess over rhyolite or basalt. Slope is 4 to 30 percent. Elevation is 4,700 to 6,000 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 43 degrees F, and the frost-free season is 80 to 110 days.

Araveton soils are near Ririe and Tetonia soils. Ririe soils have a coarse-silty control section. Tetonia soils have a pachic epipedon.

Typical pedon of Araveton extremely stony loam, 4 to 30 percent slopes, 500 feet north and 750 feet west of the southeast corner of sec. 11, T. 1 N., R. 40 E.

A11-0 to 7 inches; dark grayish brown (10YR 4/2) extremely stony loam, black (10YR 2/2) moist; weak coarse subangular blocky structure parting to weak medium granular; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; few fine tubular pores; 15 percent stones and 5 percent cobbles; mildly alkaline (pH 7.4); clear smooth boundary.

A12-7 to 12 inches; grayish brown (10YR 5/2) stony loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure parting to mod-

erate fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; few fine tubular pores; 10 percent stones and 5 percent cobbles; mildly alkaline (pH 7.6); gradual smooth boundary.

B2-12 to 21 inches; brown (10YR 5/3) stony loam, dark brown (7.5YR 4/2) moist; strong medium and coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common fine tubular pores; 10 percent stones and 5 percent cobbles; moderately alkaline (pH 8.0); clear smooth boundary.

B3ca-21 to 27 inches; pale brown (10YR 6/3) stony loam, brown (10YR 5/3) moist; moderate medium and coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; common fine tubular pores; 20 percent stones; common lime veins; strongly calcareous; moderately alkaline (pH 8.4); clear smooth boundary.

C1ca-27 to 42 inches; pale brown (10YR 6/3) stony loam, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure; very hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; many very fine and fine tubular pores; 20 percent stones; common lime veins and nodules; strongly calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

C2ca-42 to 60 inches; very pale brown (10YR 7/3) stony loam, pale brown (10YR 6/3) moist; massive; very hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; 20 percent stones; common lime veins; strongly calcareous; moderately alkaline (pH 8.4).

The 10- to 40-inch control section is dominantly stony loam, averages 18 to 23 percent clay, and is less than 35 percent rock fragments. The solum is 20 to 30 inches thick. The mollic epipedon is 7 to 14 inches thick. It is neutral to moderately alkaline. The A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3. The B horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 2 or 3.

### **Badgerton Variant**

The Badgerton Variant consists of very deep, well drained soils on river terraces and alluvial fans. These soils formed in mixed alluvium. Slope is 0 to 4 percent. Elevation is 5,500 to 6,700 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 41 degrees F, and the frost-free season is 50 to 85 days.

Badgerton Variant soils are near Hobacker soils. Hobacker soils have a loamy-skeletal control section.

Typical pedon of Badgerton Variant sandy loam, 1,340 feet south and 380 feet west of the northeast corner of sec. 21, T. 1 N., R. 44 E.

A11-0 to 13 inches; dark grayish brown (10YR 4/2) sandy loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to fine and medium subangular blocky; slightly hard, very friable; many very fine and fine roots and few medium roots; 2 percent gravel; mildly alkaline (pH 7.4); clear smooth boundary.

A12-13 to 20 inches; dark grayish brown (10YR 4/2) sandy loam, very dark grayish brown (10YR 3/2) moist; weak coarse subangular blocky structure; slightly hard, very friable; common very fine and fine roots; 2 percent gravel; mildly alkaline (pH 7.4); gradual smooth boundary.

C1-20 to 32 inches; grayish brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) moist; massive; slightly hard, very friable; common very fine and fine roots; 2 percent gravel; mildly alkaline (pH 7.4); clear smooth boundary.

IIC2-32 to 60 inches; extremely gravelly coarse sand; lime undercoating on gravel; mildly alkaline (pH 7.6).

The mollic epipedon is 10 to 16 inches thick. It is neutral or mildly alkaline. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3. It is less than 1 percent organic matter at a depth of 16 inches or more.

### **Bannock series**

The Bannock series consists of very deep, well drained soils on flood plains. These soils formed in mixed alluvium. Slope is 0 to 2 percent. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free season is about 95 to 125 days.

Bannock soils are near Bock, Harston, Packham, and Paesl soils. Bock soils are more than 40 inches thick to sand and gravel. Harston and Packham soils do not have a mollic epipedon, and Packham soils are loamy-skeletal. Paesl soils are fine-loamy over sandy or sandy-skeletal.

Typical pedon of Bannock loam, about 300 feet south and 220 feet east of the northwest corner of sec. 9, T. 1 N., R. 37 E.

A11-0 to 2 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; weak very thin platy structure parting to weak very fine granular; soft, very friable, nonsticky and slightly plastic; many very fine and fine roots; many very fine and fine interstitial pores; 5 percent gravel; slightly

calcareous; mildly alkaline (pH 7.8); abrupt wavy boundary.

A12-2 to 7 inches; grayish brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) moist; moderate thin and medium platy structure; slightly hard, friable, nonsticky and slightly plastic; many very fine and fine roots; many very fine and fine tubular pores; 5 percent gravel; slightly calcareous; moderately alkaline (pH 8.0); clear wavy boundary.

B2-7 to 13 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure; hard, firm, nonsticky and slightly plastic; common fine and very fine roots; many very fine and fine tubular pores; 10 percent gravel coated with lime on underside; slightly calcareous; moderately alkaline (pH 8.2); clear wavy boundary.

C1ca-13 to 23 inches; light brownish gray (10YR 6/2) gravelly loam, dark grayish brown (10YR 4/3) moist; moderate fine and medium subangular blocky structure; hard, firm, nonsticky and slightly plastic; many very fine and fine roots; roots matted against gravel; many very fine and fine tubular pores; 30 percent gravel coated with lime on underside; strongly calcareous; moderately alkaline (pH 8.4); gradual wavy boundary.

IIC2ca-23 to 60 inches; extremely gravelly coarse sand; 65 percent gravel coated with lime on underside; moderately alkaline (pH 8.0).

The upper part of the control section is dominantly loam to silt loam, is less than 18 percent clay, and is less than 35 percent rock fragments. The mollic epipedon is 7 to 12 inches thick. Depth to the calcic horizon is 13 to 20 inches. Reaction is mildly alkaline or moderately alkaline. The A1 or Ap horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3. The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3.

## Bock series

The Bock series consists of very deep, well drained soils on flood plains. These soils formed in alluvium derived from quartzite and sedimentary rock. Slope is 0 to 2 percent. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free season is 95 to 125 days.

Bock soils are near Ammon, Bannock, and Stan soils. Ammon soils have a coarse-silty control section. Bannock soils have loose sand and gravel at a depth of less than 40 inches. Stan soils are calcareous to the surface.

Typical pedon of Bock loam, 2,500 feet north and 1,400 feet east of the southwest corner of sec. 16, T. 2 N., R. 38 E.

A11-0 to 4 inches; grayish brown (10YR 5/2) loam, very dark brown (10YR 2/2) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; mildly alkaline (pH 7.4); clear smooth boundary.

A12-4 to 10 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure parting to weak medium subangular blocky; hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine and fine tubular pores; mildly alkaline (pH 7.4); clear smooth boundary.

B2-10 to 24 inches; pale brown (10YR 6/3) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak coarse and medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine and fine tubular pores; slightly calcareous; mildly alkaline (pH 7.4); gradual smooth boundary.

C1ca-24 to 33 inches; white (10YR 8/2) fine sandy loam, light brownish gray (10YR 6/2) moist; weak coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few fine and very fine roots; few very fine and fine tubular pores; strongly calcareous; many lime coatings on faces of peds; mildly alkaline (pH 7.6); gradual wavy boundary.

C2ca-33 to 45 inches; light gray (10YR 7/2) fine sandy loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; few very fine and fine tubular pores; moderately calcareous; few lime veins; mildly alkaline (pH 7.6); gradual wavy boundary.

IIC-45 to 60 inches; very gravelly loamy sand; lime coatings on the underside of the gravel; mildly alkaline (pH 7.8).

The 10- to 40-inch control section is dominantly fine sandy loam or loam, averages less than 18 percent clay, and is less than 35 percent rock fragments. The solum is 11 to 24 inches thick. The mollic epipedon is 8 to 14 inches thick. Depth to the calcic horizon is 12 to 24 inches. Reaction is mildly alkaline to moderately alkaline. The A1 or Ap horizon has value of 2 or 3 when moist, and it has chroma of 2 or 3. The B horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 2 or 3.

## Dranyon series

The Dranyon series consists of deep, well drained soils on mountainsides and ridges. These soils formed in material weathered from fine grained sandstone. Slope is 4 to 45 percent. Elevation is 6,000 to 8,000 feet. The average annual precipitation is about 20 inches, the

average annual air temperature is about 41 degrees F, and the frost-free season is about 30 to 80 days.

Dranyon soils are near Judkins, Nielsen, Robin, and Paulson soils. Judkins soils are moderately deep to bedrock. Nielsen soils have bedrock at a depth of less than 18 inches. Robin soils have a fine-silty control section. Paulson soils have a fine, montmorillonitic control section.

Typical pedon of Dranyon extremely stony silt loam, 4 to 45 percent slopes, about 680 feet south and 350 feet east of the northwest corner of sec. 36, T. 2 N., R. 41 E.

O-2 inches to 0; undecomposed leaves and twigs, primarily from aspen; slightly acid (pH 6.4); abrupt wavy boundary.

A11-0 to 4 inches; dark grayish brown (10YR 4/2) extremely stony silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine pores; 5 percent stones; slightly acid (pH 6.4); clear smooth boundary.

B1-4 to 20 inches; dark grayish brown (10YR 4/2) stony loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many very fine and fine pores; 15 percent stones; neutral (pH 6.6); gradual smooth boundary.

B2t-20 to 36 inches; brown (10YR 5/3) stony clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, friable, sticky and plastic; few fine and medium roots; thin patchy clay films on faces of peds; 20 percent stones; neutral (pH 7.3); gradual wavy boundary.

B3t-36 to 45 inches; light yellowish brown (10YR 6/4) stony clay loam, dark brown (7.5YR 4/4) moist; strong medium subangular blocky structure; hard, friable, sticky and plastic; few coarse roots; thin patchy clay films on peds; 30 percent stones; neutral (pH 7.3); gradual smooth boundary.

R-45 inches; interbedded sandstone and shale.

The control section is dominantly stony clay loam, averages 26 to 35 percent clay, and is 20 to 35 percent rock fragments. The mollic epipedon is 16 to 30 inches thick. The solum is 30 to 50 inches thick. Reaction is neutral to slightly acid. Depth to hard bedrock is 40 to 60 inches. The A1 horizon has value of 3 or 4 when dry and 2 or 3 when moist, and it has chroma of 1 or 2. The B2t horizon has value of 4 or 5 when dry and 3 or 4 when moist, and it has chroma of 2 or 3.

### Harston series

The Harston series consists of very deep, well drained soils on flood plains. These soils formed in mixed alluvium derived dominantly from quartzite and sedimentary

rock. Slope is 0 to 2 percent. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free season is about 95 to 125 days.

Harston soils are near Heiseton soils. Heiseton soils have mottles, and they do not have loose sand or gravel at a depth of less than 40 inches.

Typical pedon of Harston fine sandy loam, about 2,560 feet west and 150 feet south of the northeast corner of sec. 35, T. 2 N., R. 36 E.

A1-0 to 10 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine granular structure; soft, very friable; many very fine and fine roots; mildly alkaline (pH 7.4); clear smooth boundary.

C1-10 to 20 inches; pale brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) moist; weak coarse subangular blocky structure; slightly hard, very friable; common very fine and many fine roots; moderately calcareous; moderately alkaline (pH 8.0); clear smooth boundary.

C2-20 to 25 inches; light gray (10YR 7/2) fine sandy loam, brown (10YR 5/3) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable; common very fine and fine roots; moderately alkaline (pH 8.0); clear smooth boundary.

IIc-25 to 60 inches; very gravelly coarse sand; lime coatings on lower surface; mildly alkaline (pH 7.6).

The upper part of the control section is dominantly fine sandy loam that is less than 12 percent clay and less than 35 percent coarse fragments. Reaction is mildly alkaline to moderately alkaline. The Ap or A1 horizon has value of 5 to 7 when dry and 3 to 5 when moist, and it has chroma of 2 or 3.

### Heiseton series

The Heiseton series consists of very deep, moderately well drained soils on flood plains. These soils formed in alluvium derived dominantly from quartzite and sedimentary rock. Slope is 0 to 2 percent. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free season is about 95 to 125 days.

Heiseton soils are near Harston soils. Harston soils do not have mottles, but they have gravel and sand at a depth of less than 40 inches.

Typical pedon of Heiseton fine sandy loam, drained, about 2,640 feet west and 700 feet south of the northeast corner of sec. 35, T. 2 N.; R. 37 E.

A11-0 to 8 inches; grayish brown (10YR 5/2) fine sandy loam, very dark grayish brown (10YR 3/2)

moist; weak fine granular structure; soft, very friable; many very fine and fine roots; slightly calcareous; mildly alkaline (pH 7.4); clear smooth boundary.

A12-8 to 14 inches; pale brown (10YR 6/3) fine sandy loam, very dark grayish brown (10YR 3/2) moist; weak fine granular structure; soft, very friable; common very fine and fine roots; slightly calcareous; mildly alkaline (pH 7.4); clear smooth boundary.

C1-14 to 29 inches; light brownish gray (10YR 6/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; few fine faint mottles that are strong brown (7.5YR 5/6) moist; weak coarse subangular blocky structure; slightly hard, very friable; few very fine and fine roots; few medium tubular pores; slightly calcareous; mildly alkaline (pH 7.4); clear smooth boundary.

C2-29 to 44 inches; pale brown (10YR 6/3) fine sandy loam, very dark brown (10YR 4/3) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable; few very fine and fine roots; common very fine and fine tubular pores; slightly calcareous; mildly alkaline (pH 7.6); gradual smooth boundary.

C3ca-44 to 49 inches; light gray (10YR 7/2) fine sandy loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, very friable; few very fine and fine roots; moderately calcareous; mildly alkaline (pH 7.8); gradual smooth boundary.

C4ca-49 to 60 inches; light gray (10YR 7/2) loam, brown (10YR 5/3) moist; weak medium subangular blocky structure; slightly hard, very friable; 10 percent gravel coated with lime on underside; slightly calcareous; mildly alkaline (pH 7.8).

The 10- to 40-inch control section is dominantly fine sandy loam, is less than 18 percent clay, and is less than 15 percent rock fragments. Reaction is mildly alkaline or moderately alkaline. The A horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3.

### Hobacker series

The Hobacker series consists of very deep, well drained soils on flood plains. These soils formed in alluvium derived dominantly from sedimentary rock and quartzite. Slope is 0 to 10 percent. Elevation is 6,000 to 7,000 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 41 degrees F, and the frost-free season is about 50 to 85 days.

Hobacker soils are near Badgerton Variant soils. Badgerton Variant soils have a sandy control section.

Typical pedon of Hobacker gravelly loam, 0 to 4 percent slopes, about 1,200 feet west and 200 feet north of the southeast corner of sec. 17, T. 1 N., R. 44 E.

A11-0 to 4 inches; dark grayish brown (10YR 4/2) gravelly loam, very dark brown (10YR 2/2) moist; weak thin platy structure; soft, very friable, slightly sticky and slightly plastic; many very fine roots and common fine roots; 20 percent gravel; mildly alkaline (pH 7.6); clear smooth boundary.

A12-4 to 16 inches; grayish brown (10YR 5/2) very gravelly loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; 45 percent gravel and 10 percent cobbles; mildly alkaline (pH 7.6); gradual smooth boundary.

A13-16 to 22 inches; brown (10YR 5/3) extremely gravelly sandy loam, dark brown (10YR 3/3) moist; massive; soft, very friable; common very fine and fine roots; 70 percent gravel and 15 percent cobbles; slightly calcareous; mildly alkaline (pH 7.6); gradual smooth boundary.

C1-22 to 60 inches; pale brown (10YR 6/3) extremely gravelly loamy sand, brown (10YR 4/3) moist; massive; soft, very friable; few very fine and fine roots; 70 percent gravel coated with lime on underside, 25 percent cobbles; moderately calcareous; moderately alkaline (pH 8.0).

The 10- to 40-inch control section typically is gravelly or very gravelly loam. Rock fragments make up 40 to 85 percent of the control section. The mollic epipedon is 16 to 36 inches thick. Reaction is mildly alkaline to moderately alkaline. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3.

### Judkins series

The Judkins series consists of moderately deep, well drained soils on mountainsides. These soils formed in material weathered from rhyolite, rhyolitic tuff, or latite. Slope is 8 to 30 percent. Elevation is 6,000 to 7,000 feet. The average annual precipitation is 18 inches, the average annual air temperature is about 41 degrees F, and the frost-free season is about 30 to 70 days.

Judkins soils are near Dranyon soils. Dranyon soils have a pachic mollic epipedon.

Typical pedon of Judkins extremely stony loam, 8 to 30 percent slopes, about 900 feet north and 100 feet east of the southwest corner of sec. 15, T. 2 S., R. 42 E.

O1-2 inches to 0; undecomposed needles, twigs, grass, and cones; medium acid.

A11-0 to 2 inches; dark grayish brown (10YR 4/2) extremely stony loam, very dark brown (10YR 2/2) moist; weak thick platy structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; 5 percent stones; slightly acid (pH 6.5); abrupt smooth boundary.

A12-2 to 8 inches; dark grayish brown (10YR 4/2) extremely stony loam, very dark brown (10YR 2/2) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few coarse roots and many very fine and fine roots; few medium tubular pores; 50 percent stones; neutral (pH 6.6); abrupt smooth boundary.

A2-8 to 15 inches; pale brown (10YR 6/3) extremely stony loam, brown (10YR 5/3) moist; weak medium and fine subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common medium and fine roots; common fine tubular pores; 50 percent stones; slightly acid (pH 6.4); diffuse wavy boundary.

B&A-15 to 23 inches; brown (10YR 5/3) extremely stony clay loam, dark brown (10YR 4/3) moist, 30 percent pockets of pale brown (10YR 6/3); moderate medium and coarse subangular blocky structure; hard, very friable, sticky and plastic; common medium and fine roots; many very fine and fine tubular pores; thin patchy clay films; 65 percent stones; slightly acid (pH 6.4); diffuse wavy boundary.

B2t-23 to 28 inches; yellowish brown (10YR 5/4) extremely stony clay loam, dark brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, very friable, sticky and plastic; few medium and coarse roots; many very fine and fine pores; thin continuous clay films; 80 percent stones; slightly acid (pH 6.4); abrupt wavy boundary.

R-28 inches; rhyolite bedrock.

The solum is 50 to 85 percent rock fragments. Reaction is neutral or slightly acid. Depth to hard rock is 20 to 40 inches. The A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3. The B2t horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 2 to 4.

### Lanark series

The Lanark series consists of very deep, well drained soils on mountainsides (fig. 5). These soils formed in loess. Slope is 4 to 45 percent. Elevation is 6,000 to 7,000 feet. The average annual precipitation is about 16 inches, the average annual air temperature is about 41 degrees F, and the frost-free season is about 50 to 70 days.

Lanark soils are near Robin and Tetonia soils. Robin soils have an A horizon more than 24 inches thick. Tetonia soils do not have an argillic horizon.

Typical pedon of Lanark silt loam, 4 to 20 percent slopes, about 500 feet north and 1,000 feet east of the southwest corner of sec. 33, T. 1 S., R. 40 E.

A1-0 to 5 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium subangular blocky structure parting to moderate medium granular; slightly hard, very friable,

slightly sticky and slightly plastic; common very fine and fine roots; common coarse tubular pores; mildly alkaline (pH 7.4); clear smooth boundary.

B1-5 to 10 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common coarse tubular pores; mildly alkaline (pH 7.4); abrupt smooth boundary.

B2t-10 to 25 inches; brown (10YR 5/3) silty clay loam, dark brown (10YR 3/3) moist; strong medium and coarse subangular blocky structure; hard, friable, sticky and plastic; few coarse roots and common medium roots; few medium pores and common very fine and fine pores; few lamella 1/4 to 1/2 inch thick; mildly alkaline (pH 7.4); clear smooth boundary.

C1-25 to 31 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few medium and fine roots; common very fine and fine roots; neutral (pH 7.2); clear smooth boundary.

C2-31 to 41 inches; pale brown (10YR 6/3) silt loam, brown (10YR 5/3) moist; weak coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few medium and fine roots; common very fine and fine pores; mildly alkaline (pH 7.4); gradual smooth boundary.

C3ca-41 to 60 inches; very pale brown (10YR 7/3) silt loam, yellowish brown (10YR 5/4) moist; weak coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few medium and fine roots; few lime veins; moderately calcareous; mildly alkaline (pH 7.6).

The solum is 25 to 50 inches thick. The mollic epipedon is 16 to 30 inches thick. Reaction is neutral or mildly alkaline. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3. The B2t horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3. It is silt loam or silty clay loam and is 24 to 30 percent clay.

### Malm series

The Malm series consists of moderately deep, well drained soils on foot slopes of remnant volcanic cones. These soils formed in eolian deposits over rhyolite or basalt bedrock. Slope is 4 to 20 percent. Elevation is 4,600 to 5,500 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free season is about 95 to 125 days.

Malm soils are near Araveton and Ririe soils. Araveton



Figure 5. -Area of Lanark soils in foreground.

and Ririe soils have bedrock at a depth of more than 40 inches.

Typical pedon of Malm fine sandy loam, 4 to 12 percent slopes, about 1,300 feet east and 800 feet south of the northwest corner of sec. 4, T. 2 N., R. 39 E.

A1-0 to 7 inches; grayish brown (10YR 5/2) fine sandy loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure parting to weak fine granular; slightly hard, very friable; many very fine and fine roots; 2 percent gravel; mildly alkaline (pH 7.8); slightly calcareous; gradual wavy boundary.

B2-7 to 18 inches; light brownish gray (10YR 6/2) fine sandy loam, dark brown (10YR 4/3) moist; weak medium subangular blocky structure; hard, very friable; many very fine and fine roots; 5 percent gravel; moderately calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

C1ca-18 to 24 inches; light gray (10YR 7/2) fine sandy loam, brown (10YR 5/3) moist; massive; very hard, very friable; few very fine and fine roots; 10 percent gravel; strongly calcareous; common lime veins; moderately alkaline (pH 8.4); clear wavy boundary.

C2ca-24 to 28 inches; light gray (10YR 7/2) gravelly fine sandy loam, pale brown (10YR 6/3) moist; massive; extremely hard, friable; few very fine and fine roots; 5 percent cobbles and 10 percent gravel; common lime veins and lime coatings on underside of cobbles and gravel; strongly calcareous; strongly alkaline (pH 8.6); clear smooth boundary.

C3ca-28 to 38 inches; very pale brown (10YR 7/3) cobbly fine sandy loam, pale brown (10YR 6/3) moist; massive; extremely hard, friable; 10 percent cobbles, 10 percent gravel; common lime veins and lime coatings on undersides of gravel and cobbles; strongly calcareous; strongly alkaline (pH 8.6); abrupt wavy boundary.

R-38 inches; basalt bedrock; lime coatings on surface and in pores and cracks.

The 10- to 38-inch control section is dominantly fine sandy loam. It is 12 to 15 percent clay and is less than 20 percent rock fragments. Basalt bedrock is at a depth of 22 to 38 inches. Depth to the calcic horizon is 15 to 20 inches. Reaction of the profile is mildly alkaline to strongly alkaline. The A horizon has value of 5 to 7 when dry and 3 to 5 when moist, and it has chroma of 2 or 3. Basaltic sand commonly contributes to the darker colors. The B horizon has value of 5 to 7 when dry and 3 to 5 when moist, and it has chroma of 2 or 3. The Cca horizon has value of 6 or 7 when dry and 4 or 6 when moist, and it has chroma of 2 or 3.

### Nielsen series

The Nielsen series consists of shallow, well drained soils on mountainsides. These soils formed in residuum derived from sandstone or quartzite. Slope is 5 to 35 percent. Elevation is 6,000 to 7,500 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 41 degrees F, and the frost-free season is about 30 to 50 days.

Nielsen soils are near Dranyon and Paulson soils. Dranyon and Paulson soils are more than 40 inches thick.

Typical pedon of a Nielsen extremely flaggy loam in an area of Paulson-Nielsen complex, 5 to 35 percent slopes, about 1/4 mile north of Castle Rock; 960 feet east and 540 feet north of southwest corner of sec. 32, T. 1 S., R. 42 E.

A1-0 to 6 inches; brown (10YR 4/3) extremely flaggy loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; 30 percent flagstones and 20 percent angular cobbles; neutral (pH 6.8); clear smooth boundary.

B21t-6 to 10 inches; brown (10YR 5/3) extremely flaggy clay loam, very dark brown (10YR 3/2) moist; moderate medium subangular blocky structure;

slightly hard, friable, slightly sticky and slightly plastic; many very fine and fine roots; 30 percent flagstones and 45 percent angular cobbles; thin patchy clay films; neutral (pH 7.0); abrupt smooth boundary.

B22t-10 to 18 inches; brown (10YR 5/3) extremely flaggy sandy clay loam, dark yellowish brown (10YR 4/4) moist; moderate medium subangular blocky structure; hard, friable, slightly sticky and slightly plastic; common very fine and fine roots; thin continuous clay films; 65 percent flagstones and 10 percent angular cobbles; neutral (pH 7.2); irregular wavy boundary.

R-18 inches; partly weathered and fractured sandstone bedrock.

The control section is sandy clay loam or clay loam and is 25 to 32 percent clay and 40 to 75 percent angular rock fragments. Depth to sandstone or quartzite bedrock is 14 to 18 inches. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3. The Bt horizon has value of 4 to 6 when dry and 2 to 4 when moist, and it has chroma of 2 to 4.

### Packham series

The Packham series consists of very deep, well drained soils on flood plains. These soils formed in mixed alluvium. Slope is 0 to 2 percent. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free season is about 95 to 125 days.

Packham soils are near Bannock soils. Bannock soils have strongly contrasting textures in the control section and have a calcic horizon.

Typical pedon of Packham gravelly loam, about 1,320 feet north and 1,320 feet east of the southwest corner of sec. 6, T. 3 N., R. 38 E.

A11-0 to 4 inches; dark brown (10YR 4/3) gravelly loam, very dark grayish brown (10YR 3/2) moist; weak medium platy structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common fine and very fine pores; 25 percent gravel; mildly alkaline (pH 7.6); clear smooth boundary.

A12-4 to 8 inches; grayish brown (10YR 5/2) very gravelly loam, dark grayish brown (10YR 4/2) moist; weak fine subangular blocky structure parting to weak fine granular; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common very fine and fine pores; 35 percent gravel; mildly alkaline (pH 7.6); clear smooth boundary.

B2-8 to 15 inches; brown (10YR 5/3) very gravelly loam, dark grayish brown (10YR 4/2) moist; moderate fine and medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly



plastic; common very fine and fine roots; 40 percent gravel; mildly alkaline (pH 7.8); gradual smooth boundary.  
C1-15 to 23 inches; pale brown (10YR 6/3) very gravelly sandy loam, brown (10YR 5/3) moist; massive; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; 60 percent gravel; mildly alkaline (pH 7.8); gradual smooth boundary.  
C2-23 to 60 inches; pale brown (10YR 6/3) extremely gravelly loamy sand, brown (10YR 5/3) moist; massive; slightly hard, very friable; few fine and very fine roots; 80 percent gravel; slightly calcareous; mildly alkaline (pH 7.8).

The 10- to 40-inch control section is 12 to 18 percent clay and more than 35 percent rock fragments. The A horizon has value of 4 or 5 when dry and 3 or 4 when moist, and it has chroma of 2 or 3. The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3.

### Paesl series

The Paesl series consists of very deep, well drained soils on flood plains. These soils formed in mixed alluvium. Slope is 0 to 2 percent. Elevation is 4,600 to 4,800 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free season is 100 to 125 days.

Paesl soils are near Bannock and Paul soils. Bannock soils have a coarse-loamy over sandy-skeletal control section. Paul soils are deep to sand and gravel.

Typical pedon of Paesl silty clay loam, about 200 feet east and 50 feet north of the southwest corner of sec. 22, T. 3 N., R. 38 E.

Ap1-0 to 5 inches; brown (7.5YR 5/2) silty clay loam, dark brown (7.5YR 3/2) moist; weak fine granular structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; slightly calcareous; mildly alkaline (pH 7.5); clear smooth boundary.

Ap2-5 to 10 inches; reddish gray (10YR 5/2) silty clay loam, dark brown (7.5YR 3/2) moist; moderate medium angular blocky structure; hard, friable, sticky and plastic; common very fine and fine roots; slightly calcareous; moderately alkaline (pH 8.0); gradual smooth boundary.

B2ca-10 to 17 inches; light brownish gray (7.5YR 6/2) silty clay loam, dark brown (7.5YR 4/2) moist; moderate medium angular blocky structure; hard, friable, sticky and plastic; few very fine and fine roots; few lime veins; moderately calcareous; moderately alkaline (pH 8.0); gradual smooth boundary.

C1ca-17 to 25 inches; light gray (10YR 7/2) silty clay loam, brown (7.5YR 5/4) moist; moderate medium

subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; few lime veins; moderately calcareous; moderately alkaline (pH 8.0); irregular wavy boundary.

IIC2-25 to 60 inches; very gravelly loamy coarse sand; lime coating on undersides of gravel.

The upper 10 to 25 inches of the 10- to 40-inch control section is dominantly silty clay loam or silt loam that averages 20 to 35 percent clay and is less than 15 percent rock fragments. The mollic epipedon is 7 to 12 inches thick. The A horizon has hue of 5YR or 7.5YR and chroma of 2 or 3. The B2 horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3. The Cca horizon has value of 6 or 7 when dry and 4 to 6 when moist, and it has chroma of 2 to 4.

### Pancheri series

The Pancheri series consists of very deep, well drained soils on basalt plains. These soils formed in loess. Slope is 0 to 25 percent. Elevation is 4,600 to 5,400 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free period is about 95 to 120 days.

Pancheri soils are similar to Polatis soils. Polatis soils have bedrock at a depth of less than 40 inches.

Typical pedon of Pancheri silt loam, 0 to 2 percent slopes, about 1,500 feet east and 10 feet north of the southwest corner of sec. 25, T. 3 N., R. 35 E.

Ap-0 to 6 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate thin platy structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; slightly calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

B2-6 to 10 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; moderate medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; moderately calcareous; moderately alkaline (pH 8.4); clear smooth boundary.

C1ca-10 to 17 inches; light gray (10YR 7/2) silt loam, brown (10YR 5/3) moist; moderate coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; few lime streaks; strongly calcareous; strongly alkaline (pH 8.8); clear smooth boundary.

C2ca-17 to 33 inches; light gray (10YR 7/2) silt loam, brown (10YR 5/3) moist; massive; hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; common lime veins; strongly calcareous; strongly alkaline (pH 8.8); clear smooth boundary.

C3ca-33 to 60 inches; very pale brown (10YR 7/3) silt loam, pale brown (10YR 6/3) moist; massive; very hard, very friable, slightly sticky and slightly plastic; few fine roots; moderately calcareous; strongly alkaline (pH 8.8).

The 10- to 40-inch control section is dominantly silt loam that averages 5 to 18 percent clay and is less than 15 percent particles coarser than very fine sand. Reaction is mildly alkaline to strongly alkaline. The A horizon has value of 5 to 7 when dry and 3 to 5 when moist, and it has chroma of 2 or 3. The B horizon has value of 5 or 6 when dry and 3 or 4 when moist. Cultivation mixes the A horizon and all or part of the B horizon in some pedons. The Cca horizon has value of 6 to 8 when dry and 4 to 6 when moist, and it has chroma of 2 or 3.

### Paul series

The Paul series consists of very deep, well drained soils on flood plains. These soils formed in alluvium. Slope is 0 to 2 percent. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free season is about 90 to 120 days.

Paul soils are similar to Paesl soils. They are near Ammon and Paesl soils. Paesl soils are moderately deep to sand and gravel. Ammon soils are coarse-silty.

Typical pedon of Paul silty clay loam, about 4 miles northeast of Idaho Falls; about 1,320 feet west and 200 feet north of the southeast corner of sec. 36, T. 3 N., R. 38 E.

Ap1-0 to 5 inches; reddish gray (5YR 5/2) silty clay loam, dark grayish brown (5YR 3/2) moist; strong fine angular blocky structure; hard, friable, sticky and plastic; common fine and very fine roots; moderately calcareous; mildly alkaline (pH 7.6); clear smooth boundary.

Ap2-5 to 13 inches; reddish brown (5YR 5/3) silty clay loam, dark grayish brown (5YR 3/2) moist; strong medium angular blocky structure; hard, friable, sticky and plastic; common fine and very fine roots; moderately calcareous; mildly alkaline (pH 7.6); clear smooth boundary.

B2ca-13 to 45 inches; light reddish brown (5YR 6/3) silty clay loam, reddish brown (5YR 4/3) moist; moderate coarse and medium subangular blocky structure; hard, friable, sticky and plastic; few fine and very fine roots; few fine and medium tubular pores; strongly calcareous; moderately alkaline (pH 8.0); gradual smooth boundary.

C1ca-45 to 58 inches; pale brown (10YR 6/3) silt loam, yellowish brown (10YR 5/4) moist; weak coarse and medium subangular blocky structure; slightly hard, very friable, sticky and plastic; few fine and medium tubular pores; few very fine roots; strongly calcare-

ous; moderately alkaline (pH 8.2); clear smooth boundary.

IIC2ca-58 to 60 inches; very gravelly coarse sand; 80 percent gravel and 10 percent cobbles; gravel and cobbles are coated with lime.

The 10- to 40-inch control section is dominantly silty clay loam or silt loam that is 23 to 35 percent clay and less than 15 percent gravel and cobbles. Strongly contrasting sand and gravel, where present, are at a depth of 40 inches or more. The mollic epipedon is 12 to 18 inches thick. It is mildly alkaline to moderately alkaline. The A horizon has hue of 7.5YR or 5YR, value of 4 or 5 when dry and 2 or 3 when moist, and chroma of 2 or 3 when moist. The B horizon has hue of 7.5YR or 5YR, value of 4 to 6 when dry and 3 to 4 when moist, and chroma of 2 or 3 when moist. The C horizon has hue of 5YR to 10YR, value of 6 or 7 when dry and 5 or 6 when moist, and chroma of 2 to 4.

### Paulson series

The Paulson series consists of very deep, well drained soils on mountainsides. These soils formed in residuum or alluvium derived dominantly from shale. Slope is 4 to 35 percent. Elevation is 6,000 to 7,500 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 41 degrees F, and the frost-free season is about 30 to 50 days.

Paulson soils are near Dranyon, Nielsen, and Robin soils. Dranyon soils have bedrock at a depth of 40 to 60 inches, and Robin soils have an A horizon more than 24 inches thick. Nielsen soils have bedrock at a depth of less than 20 inches.

Typical pedon of Paulson silt loam, 4 to 12 percent slopes, about 1,320 feet east and 1,100 feet north of the southwest corner of sec. 28, T. 1 N., R. 41 E.

Ap11-0 to 6 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; few fine pores; neutral (pH 7.0); clear smooth boundary.

B21t-6 to 17 inches; reddish gray (5YR 5/2) silty clay loam, dark reddish brown (5YR 3/2) moist; moderate coarse subangular blocky structure; hard, friable, sticky and plastic; few very fine and fine roots; few fine pores; thin patchy clay films on faces of peds; neutral (pH 7.0); clear smooth boundary.

B22t-17 to 37 inches; reddish brown (5YR 5/3) silty clay, dark reddish brown (2.5YR 3/4) moist; strong coarse subangular blocky structure; very hard, firm, very sticky and very plastic; few very fine and fine roots; thin continuous clay films on faces of peds; neutral (pH 6.8); clear smooth boundary.

B23t-37 to 44 inches; reddish brown (5YR 5/3) silty clay loam, dark reddish brown (2.5YR 3/4) moist; strong coarse subangular blocky structure; very hard, friable, sticky and plastic; thin continuous clay films on faces of peds; neutral (pH 6.8); gradual smooth boundary.

B3-44 to 60 inches; reddish brown (5YR 5/4) silty clay loam, dark reddish gray (5YR 4/2) moist; strong medium coarse subangular and angular blocky structure; very hard, friable, sticky and plastic; neutral (pH 6.8).

The control section is dominantly silty clay, silty clay loam, or clay and is 35 to 45 percent clay. It is 0 to 15 percent rock fragments. The mollic epipedon is 16 to 22 inches thick. The A1 horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3. The B2t horizon has value of 4 to 6 when dry and 3 or 4 when moist, and it has chroma of 3 or 4.

### Polatis series

The Polatis series consists of moderately deep, well drained soils on basalt plains. These soils formed in loess over basalt bedrock. Slope is 2 to 25 percent. Elevation is 4,600 to 5,400 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free season is about 95 to 120 days.

Polatis soils are similar to Pancheri soils. Pancheri soils do not have bedrock at a depth of less than 40 inches.

Typical pedon of a Polatis silt loam in an area of Polatis-Rock outcrop complex, 2 to 25 percent slopes, about 2,650 feet east and 50 feet south of the northwest corner of sec. 14, T. 2 N., R. 36 E.

A1-0 to 6 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; common very fine and fine roots; slightly calcareous; moderately alkaline (pH 8.2); clear smooth boundary.

B2-6 to 9 inches; pale brown (10YR 6/3) silt loam, dark brown (10YR 4/3) moist; moderate thin platy structure parting to moderate fine granular; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; few fine interstitial pores; slightly calcareous; strongly alkaline (pH 8.6); gradual smooth boundary.

C1ca-9 to 22 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; moderate coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; common fine interstitial pores;

strongly calcareous; strongly alkaline (pH 9.0); gradual smooth boundary.

C2-22 to 31 inches; very pale brown (10YR 7/3) silt loam, brown (10YR 5/3) moist; massive; hard, very friable, slightly sticky and slightly plastic; common very fine and fine interstitial pores; moderately calcareous; strongly alkaline (pH 9.0); abrupt wavy boundary.

R-31 inches; basalt bedrock with coating of calcium carbonate on surface and in cracks.

The control section is dominantly silt loam that is 5 to 18 percent clay. Bedrock is at a depth of 25 to 39 inches. The A horizon has value of 5 to 7 when dry and 3 to 5 when moist. The thin cambic horizon has been destroyed by plowing in some pedons. Where present, it has value of 5 to 7 when dry and 3 or 4 when moist. The Cca horizon has value of 6 to 8 when dry and 4 to 6 when moist, and it has chroma of 2 or 3.

### Potell series

The Potell series consists of very deep, well drained soils on foothills. These soils formed in loess. Slope is 0 to 60 percent. Elevation is 4,600 to 5,300 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free season is about 95 to 110 days.

Potell soils are near Ammon and Ririe soils. Ammon and Ririe soils have a mollic epipedon.

Typical pedon of Potell silt loam, 4 to 12 percent slopes, about 700 feet west of the southeast corner of sec. 15, T. 3 N., R. 40 E.

Ap-0 to 6 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; moderate very thick platy structure parting to weak fine granular; slightly hard, friable, nonsticky and slightly plastic; few very fine and fine roots; few very fine and fine pores; moderately calcareous; moderately alkaline (pH 8.2); abrupt smooth boundary.

C1-6 to 10 inches; light brownish gray (10YR 6/2) silt loam, dark grayish brown (10YR 4/2) moist; weak coarse subangular blocky structure; slightly hard, friable, nonsticky and slightly plastic; few very fine and fine roots; many very fine tubular pores; moderately calcareous; moderately alkaline (pH 8.2); clear wavy boundary.

C2-10 to 20 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; weak very coarse prismatic structure parting to weak coarse subangular blocky; slightly hard, friable, nonsticky and slightly plastic; few very fine and fine roots; many fine tubular pores; moderately calcareous; moderately alkaline (pH 8.4); clear wavy boundary.

C3ca-20 to 43 inches; light gray (10YR 7/2) silt loam, grayish brown (10YR 5/2) moist; weak coarse su-

angular blocky structure; hard, firm, nonsticky and slightly plastic; few very fine and fine roots; common fine tubular pores; many slightly lime coated cicada krotovinas; strongly calcareous; moderately alkaline (pH 8.4); gradual irregular boundary.

C4ca-43 to 60 inches; light gray (10YR 7/2) silt loam, brown (10YR 5/3) moist; weak very coarse prismatic structure; slightly hard, very friable, nonsticky and slightly plastic; few cicada krotovinas; strongly calcareous; moderately alkaline (pH 8.4); gradual irregular boundary.

The 10- to 40-inch control section is silt or silt loam that is 8 to 12 percent clay. The C1 and C2 horizons have value of 6 or 7 when dry and 4 or 5 when moist, and they have chroma of 2 or 3 when dry or moist.

### Rin series

The Rin series consists of very deep, well drained soils on mountainsides. These soils formed in loess. Slope is 4 to 45 percent. Elevation is 5,500 to 7,000 feet. The average annual precipitation is about 18 inches, the average annual air temperature is about 41 degrees F, and the frost-free season is about 50 to 90 days.

Rin soils are near Ririe, Robin, and Tetonia soils. Ririe and Tetonia soils have a calcic horizon. Robin soils have an argillic horizon.

Typical pedon of Rin silt loam, 12 to 45 percent slopes, about 0.3 mile south of the northwest corner of sec. 35, T. 3 N., R. 39 E.

A11-0 to 7 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; neutral (pH 7.2); gradual smooth boundary.

A12-7 to 28 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; weak coarse subangular blocky structure parting to weak fine granular; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; neutral (pH 6.6); gradual smooth boundary.

B21-28 to 36 inches; brown (10YR 5/3) silt loam, dark grayish brown (10YR 4/2) moist; moderate medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; few organic stains on some faces of peds, very dark grayish brown (10YR 3/2) moist; neutral (pH 6.8); gradual smooth boundary.

B22-36 to 60 inches; pale brown (10YR 6/3) silt loam, brown (10YR 4/3) moist; moderate medium subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; neutral (pH 6.6).

The 10- to 40-inch control section is silt loam that is 10 to 18 percent clay. The mollic epipedon is 19 to 28 inches thick. It is medium acid to neutral. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3. The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 to 4.

### Ririe series

The Ririe series consists of very deep, well drained soils on foothills. These soils formed in loess. Slope is 0 to 30 percent. Elevation is 5,200 to 6,200 feet. The average annual precipitation is about 13 inches, the average annual air temperature is about 42 degrees F, and the frost-free season is about 70 to 100 days.

Ririe soils are near Araveton, Malm, Potell, Rin, and Tetonia soils. Potell soils do not have a mollic epipedon. Rin soils do not have a calcic horizon. Tetonia soils have a pachic epipedon. Araveton soils are fine-loamy. Malm soils are moderately deep and coarse-loamy.

Typical pedon of Ririe silt loam, 4 to 12 percent slopes, about 1/2 mile south of the northeast corner of sec. 24, T. 2 N., R. 39 E.

A11-0 to 8 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate thick platy structure parting to weak medium granular; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; mildly alkaline (pH 7.4); abrupt smooth boundary.

B2-8 to 15 inches; grayish brown (10YR 5/2) silt loam, very dark grayish brown (10YR 3/2) moist; moderate coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; slightly calcareous; mildly alkaline (pH 7.4); clear smooth boundary.

C1ca-15 to 29 inches; white (10YR 8/2) silt loam, light brownish gray (10YR 6/2) moist; moderate coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; strongly calcareous, lime coated peds; moderately alkaline (pH 8.2); gradual smooth boundary.

C2ca-29 to 42 inches; light gray (10YR 7/1) silt loam, pale brown (10YR 6/3) moist; moderate coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few very fine and fine roots; strongly calcareous, common lime streaks; moderately alkaline (pH 8.2); gradual smooth boundary.

C3ca-42 to 60 inches; gray (10YR 6/1) silt loam, grayish brown (10YR 5/2) moist; massive; hard, very friable, slightly sticky and slightly plastic; few fine roots; slightly calcareous, few lime streaks; moderately alkaline (pH 8.2).

The 10- to 40-inch control section is dominantly silt loam that is 12 to 18 percent clay. The mollic epipedon is 11 to 15 inches thick. It is mildly alkaline to strongly alkaline. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3. Content of organic matter is 2 to 4 percent. The Cca horizon has value of 6 to 8 when dry and 3 to 6 when moist, and it has chroma of 1 to 3.

### Robin series

The Robin series consists of very deep, well drained soils on foothills. These soils formed in loess. Slope is 4 to 30 percent. Elevation is 6,000 to 7,500 feet. The average annual precipitation is about 20 inches, the average annual air temperature is about 41 degrees F, and the frost-free season is about 30 to 50 days.

Robin soils are near Dranyon, Lanark, Rin, Paulson, and Tetonia soils. Dranyon soils have a fine-loamy control section. Dranyon, Lanark, and Paulson soils have an argillic horizon at a depth of more than 24 inches. Rin and Tetonia soils do not have an argillic horizon.

Typical pedon of Robin silt loam, 4 to 30 percent slopes, about 2,600 feet south and 800 feet west of the northeast corner of sec. 34, T. 1 N., R. 39 E.

A11-0 to 10 inches; dark grayish brown (10YR 4/2) silt loam, very dark brown (10YR 2/2) moist; moderate medium subangular blocky structure parting to weak medium granular; slightly hard, very friable, slightly sticky and slightly plastic; many very fine and fine roots; many fine tubular pores; slightly acid (pH 6.2); clear smooth boundary.

A12-10 to 18 inches; dark grayish brown (10YR 4/2) silt loam, very dark grayish brown (10YR 3/2) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; many fine tubular pores; slightly acid (pH 6.4); clear smooth boundary.

A13-18 to 25 inches; brown (10YR 5/3) silt loam, dark brown (10YR 3/3) moist; weak medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common very fine and fine roots; many fine tubular pores; neutral (pH 6.6); gradual wavy boundary.

B21t-25 to 35 inches; brown (7.5YR 5/2) silty clay loam, dark brown (7.5YR 4/4) moist; moderate coarse subangular blocky structure; hard, friable; sticky and plastic; common very fine roots and few fine roots; many fine tubular pores; thin continuous clay films; few silica coatings on vertical faces of peds; neutral (pH 6.6); gradual wavy boundary.

B22t-35 to 41 inches; brown (7.5YR 5/2) silty clay loam, brown (7.5YR 5/4) moist; moderate medium angular blocky structure; hard, friable, sticky and plastic; common very fine roots; common fine tubu-

lar pores; thin continuous clay films; common silica coatings on vertical faces of peds; neutral (pH 6.6); gradual smooth boundary.

B23t-41 to 80 inches; brown (7.5YR 5/2) silty clay loam, brown (7.5YR 5/4) moist; moderate coarse subangular and moderate medium angular blocky structure; hard, friable, sticky and plastic; common very fine roots; common fine tubular pores; thin continuous clay films; many silica coatings on vertical faces of peds; neutral (pH 6.8); gradual smooth boundary.

The argillic horizon is dominantly silty clay loam or silt loam that is 24 to 30 percent clay. The mollic epipedon is 24 to 26 inches thick. It is medium acid to neutral. The A1 horizon has value of 3 to 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3. The B2t horizon has value of 5 or 6 when dry and 4 or 5 when moist, and it has chroma of 2 to 4.

### Stan series

The Stan series consists of very deep, well drained soils on flood plains. These soils formed in alluvium derived from mixed sources. Slope is 0 to 4 percent. Elevation is 4,600 to 5,000 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free season is about 100 to 125 days.

Stan soils are near Bannock, Bock, and Wolverine soils. Bannock soils have loose sand and gravel at a depth of more than 40 inches. Bock soils are noncalcareous. Wolverine soils have a sandy control section.

Typical pedon of Stan sandy loam, about 2,400 feet east and 1,800 feet north of the southwest corner of sec. 6, T. 2 N., R. 38 E.

A1-0 to 13 inches; brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) moist; weak fine granular structure; soft, very friable; many very fine and fine roots; slightly calcareous; mildly alkaline (pH 7.4); clear smooth boundary.

B21-13 to 26 inches; pale brown (10YR 6/3) sandy loam; dark brown (10YR 4/3) moist; weak medium subangular blocky structure parting to weak fine granular; soft, very friable; common very fine and fine roots; many fine and medium tubular pores and few large tubular pores; slightly calcareous; mildly alkaline (pH 7.6); clear smooth boundary.

B22-26 to 34 inches; pale brown (10YR 6/3) fine sandy loam, brown (10YR 4/3) moist; moderate medium and coarse subangular blocky structure; slightly hard, very friable; common very fine and fine roots; many fine and medium tubular pores; slightly calcareous; mildly alkaline (pH 7.6); clear wavy boundary.

C1ca-34 to 51 inches; very pale brown (10YR 7/3) fine sandy loam, light brownish gray (10YR 6/2) moist;

massive; hard, very friable; few fine and medium roots; many very fine and fine tubular pores; common lime veins; strongly calcareous; mildly alkaline (pH 7.8); clear smooth boundary.

C2ca-51 to 55 inches; very pale brown (10YR 7/4) fine sandy loam, pale brown (10YR 6/3) moist; massive; slightly hard, very friable; few very fine and fine roots; many very fine and fine tubular pores; common lime veins and coatings of calcium carbonate; strongly calcareous; mildly alkaline (pH 7.8); abrupt wavy boundary.

IIC-55 to 60 inches; very pale brown, extremely gravelly coarse sand; lime coatings on underside of gravel and cobbles; 70 percent gravel and 10 percent cobbles; mildly alkaline (pH 7.8).

The 10- to 40-inch control section is fine sandy loam or sandy loam and is 6 to 10 percent clay and less than 15 percent rock fragments. The solum is 12 to 34 inches thick. The mollic epipedon is 8 to 16 inches thick. It is mildly alkaline to moderately alkaline. The Ap or A1 horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3. The B horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3.

### **Tetonia series**

The Tetonia series consists of very deep, well drained soils on mountainsides and foothills. These soils formed in loess. Slope is 0 to 30 percent. Elevation is 5,500 to 7,000 feet. The average annual precipitation is about 15 inches, the average annual air temperature is about 42 degrees F, and the frost-free season is about 50 to 80 days.

Tetonia soils are near Araveton, Rin, Ririe, Lanark, and Robin soils. Araveton and Ririe soils do not have a pachic horizon. Rin soils are noncalcareous to a depth of 60 inches or more. Lanark and Robin soils have an argillic horizon.

Typical pedon of Tetonia silt loam, 4 to 12 percent slopes, about 10 miles southeast of Ririe, 1,320 feet north and 425 feet east of the southwest corner of sec. 18, T. 3 N., R. 42 E.

Ap-0 to 8 inches; grayish brown (10YR 5/2) silt loam, very dark brown (10YR 3/2) moist; weak fine granular structure; soft, very friable, slightly sticky and slightly plastic; many very fine and fine roots; common fine pores; mildly alkaline (pH 7.4); clear smooth boundary.

B1-8 to 15 inches; grayish brown (10YR 5/2) silt loam, dark brown (10YR 3/3) moist; weak medium subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; common fine pores; mildly alkaline (pH 7.6); clear smooth boundary.

B21-15 to 22 inches; grayish brown (10YR 5/2) silt loam, dark brown (10YR 3/3) moist; moderate medium and coarse subangular blocky structure; slightly hard, very friable, slightly sticky and slightly plastic; common fine roots; common fine pores; mildly alkaline (pH 7.7); clear smooth boundary.

B22ca-22 to 36 inches; light brownish gray (10YR 6/2) silt loam, grayish brown (10YR 5/2) moist; moderate medium and coarse subangular blocky structure; hard, very friable, slightly sticky and slightly plastic; few fine roots; strongly calcareous, common lime streaks and lime nodules; moderately alkaline (pH 8.1); clear wavy boundary.

Cca-36 to 60 inches; light gray (10YR 7/2) silt loam, pale brown (10YR 6/3) moist; massive; hard, very friable, slightly sticky and slightly plastic; few fine roots; moderately calcareous, common lime veins and coatings; moderately alkaline (pH 7.9); clear smooth boundary.

The control section is silt loam that is 12 to 16 percent clay. Depth to the calcic horizon is 19 to 40 inches. The mollic epipedon is 19 to 27 inches thick. It is neutral to moderately alkaline. The A horizon has value of 4 or 5 when dry and 2 or 3 when moist, and it has chroma of 2 or 3.

### **Wolverine series**

The Wolverine series consists of very deep, excessively drained soils on sand dunes. These soils formed in eolian deposits. Slope is 0 to 20 percent. Elevation is 4,600 to 5,500 feet. The average annual precipitation is about 10 inches, the average annual air temperature is about 43 degrees F, and the frost-free season is about 90 to 125 days.

Wolverine soils are near Bannock and Stan soils. Bannock soils are moderately deep to sand and gravel. Bannock and Stan soils have a mollic epipedon.

Typical pedon of Wolverine sand, 0 to 20 percent slopes, about 2,600 feet west and 1,200 feet north of the southeast corner of sec. 4, T. 1 N., R. 38 E.

A1-0 to 5 inches; light brownish gray (10YR 6/2) sand, brown (10YR 4/3) moist; single grain; loose; many very fine and fine roots; 35 percent basaltic sand grains; slightly calcareous; mildly alkaline (pH 7.4); clear smooth boundary.

C-5 to 60 inches; pale brown (10YR 6/3) sand, brown (10YR 4/3) moist; single grain; loose; very friable; few fine and medium roots; slightly calcareous; 35 percent basaltic sand grains; mildly alkaline (pH 7.4).

The A horizon has value of 5 or 6 when dry and 3 or 4 when moist, and it has chroma of 2 or 3. The presence of 10 to 35 percent very dark gray basalt sand accounts, in part, for the darker colors. The C horizon has value of

6 or 7 when dry and 4 or 5 when moist, and it has chroma of 2 or 3.

## Formation of the soils

The factors that determine the kind of soil that forms in a given area are the composition of the parent material, the climate under which the soil material accumulated or weathered, the relief and drainage, the plants and animals on and in the soil, and the length of time that the factors of soil formation have acted on the soil material.

The survey area can be divided into five broad areas. The soils that are forming in these areas distinctly differ as a result of the interactions of the five factors of soil formation.

The first area is west of the Snake River. It consists of a thin to relatively thick, loess-covered lava plain of Snake River Basalt that ranges in age from Pleistocene to Recent. The plain is nearly level to sloping in areas of the thick loess deposits. It is more irregular in places where the loess is thinner. The Recent basalt flows on the southern part of the plain are nearly barren of vegetation and have a very rough, irregular surface. The irregularity of the surface greatly influences the depth of the soils. The deep Panchari soils and the moderately deep Polatis soils formed in the loess on this plain. The moderately deep Malm soils formed in sandy eolian material derived from alluvium deposited by the Snake River.

This area receives low rainfall and is characterized by hot, dry summers and cold winters. Under these conditions, weathering of minerals takes place slowly and the minerals are only slightly leached out of the root zone. Lime has been leached to a depth of 6 to 12 inches. Little redistribution of clay has taken place. Because the vegetation is sparse, the surface layer is thin.

The second area consists of alluvial soils deposited as wide, nearly level terraces by the Snake River and its tributaries. Most of these deposits are very deep beds of waterworn gravel that is of mixed origin and is overlain by loamy or sandy alluvium. The parent material of the Bannock, Bock, Harston, Heiseton, and Stan soils was deposited mainly by the Snake River. The Paul and Paesl soils formed in clayey outwash from Sand Creek. The Ammon soils formed in alluvium derived from loess washed from the foothills in the central part of the survey area by many small tributaries of the Snake River.

This area receives low rainfall and is characterized by hot, dry summers and cold winters. The soils receive additional moisture from flooding and runoff from higher lying areas. Plant growth has been greater, which has provided more organic matter and thus produced a thicker surface layer. Calcium carbonate and other minerals have been leached to a greater depth. Burrowing by rodents and other animals has mixed the underlying gravel with the surface material, so most of the soils on

terraces have at least a few pebbles scattered over the surface and throughout the profile. Most of these soils are so young that clay layers have not yet been formed by the leaching of clay particles from the upper layers.

The third area, in the central part of the survey area, consists of foothills that are covered mainly by loess. The soils are underlain by rhyolite, basalt, or a variety of sedimentary sandstones and shales. Willow Creek and Greys Lake Outlet and their tributaries have cut deep canyons into the foot slopes, exposing the bedrock and producing a complex of shallow to very deep soils on the canyon walls.

The foothills begin at the eastern edge of the river terraces and ascend gradually in an easterly direction to the Caribou Range. Precipitation increases with elevation. Potell and Ririe soils, at the lower end of the foothills, receive 10 to 13 inches of precipitation. Tetonia, Rin, Robin, and Lanark soils, at the upper end of the foothills, receive 13 to 18 inches of precipitation.

The greater precipitation in this area has produced more abundant vegetation, which increases the organic matter content of the soils. At the lower elevations, calcium carbonate has been leached to a depth of about 15 inches in the Ririe soils. Geological erosion has removed soil material from the Potell soils about as rapidly as it has been produced. Therefore, these soils have little topsoil and have calcium carbonate throughout the profile. At higher elevations, where the precipitation is greater, the calcium carbonate has been leached to a depth of 25 inches or more, and in the Lanark and Robin soils the translocation of clay is evident in the subsoil.

The fourth area consists of steep, hilly and mountainous soils in the southeastern part of the survey area. This area has probably received as much loess as the areas on the foothills and plains, but erosion has removed much of this material nearly as rapidly as it has been deposited. For this reason, many of the soils on the mountains are strongly influenced by the underlying bedrock. Some of these soils in this area are in the Judkins, Dranyon, Nielsen, and Paulson series.

The soils at the higher elevations in the mountain valleys and on mountainsides formed under a colder climate than the soils on the foothills and plains. This effect on soil formation has been further modified by differences in exposure and other factors. The higher rainfall leaches the calcium carbonate to a greater depth and promotes a greater accumulation of organic matter. Precipitation and leaching are adequate to cause the accumulation of a considerable amount of clay in the subsoil. Calcium carbonate in many places is leached to a depth of more than 60 inches. The soils in the mountain valleys, such as those of the Robin and Lanark series, reflect this climatic environment.

The fifth area is in the extreme eastern part of the survey area. It includes Swan and Conant Valleys, Pine Bench, and Antelope Flat. Areas in the lowest part of Swan Valley have received gravelly and cobbly outwash

from the Snake River. The Hobacker and Badgerton Variant soils formed in this material. Areas of wind-laid soils on long slopes extend from the mountains to the outwash terraces. Tetonia and Rin are the main soils on these slopes. The same soils are on Pine Bench, a plateau in the extreme northern part of Swan Valley, and on Antelope Flat. Pine Bench and Antelope Flat are parts of the same landscape. They are separated by the Snake River, which has carved a deep, precipitous canyon in the basalt between them and along the eastern side of Antelope Flat. Conant Valley was formed by a bend of the Snake River, between Swan Valley and Antelope Flat, and is covered with alluvium from the Snake River and with outwash from the surrounding hills.

The annual precipitation in this area is about 13 to 16 inches. It has produced more vegetation and therefore more organic matter in the surface layer than in areas with less precipitation. Also, lime has been leached to a greater depth. The north- and east-facing slopes receive more snow because of the prevailing winds, and the effective precipitation is greater. The Tetonia soils generally formed on ridgetops and on south- and west-facing slopes. The Rin soils formed on north- and east-facing slopes and in other areas where snow accumulates.

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Glossary

**ABC soil.** A soil having an A, a B, and a C horizon.

**Aeration, soil.** The exchange of air in soil with air from the atmosphere. The air in a well aerated soil is similar to that in the atmosphere; the air in a poorly

aerated soil is considerably higher in carbon dioxide and lower in oxygen.

**Alkali (sodic) soil.** A soil having so high a degree of alkalinity (pH 8.5 or higher), or so high a percentage of exchangeable sodium (15 percent or more of the total exchangeable bases), or both, that plant growth is restricted.

**Alluvium.** Material, such as sand, silt, or clay, deposited on land by streams.

**Area reclaim** (in tables). An area difficult to reclaim after the removal of soil for construction and other uses. Revegetation and erosion control are extremely difficult.

**Available water capacity (available moisture capacity).** The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field moisture capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil. The capacity, in inches, in a 60-inch profile or to a limiting layer is expressed as-

	Inches
Very low .....	less than 2.5
Low .....	2.5 to 3.75
Moderate .....	3.75 to 5.0
High .....	5.0 to 7.5
Very high.....	7.5 to 11

**Bedrock.** The solid rock that underlies the soil and other unconsolidated material or that is exposed at the surface.

**Bottom land.** The normal flood plain of a stream, subject to frequent flooding.

**Boulders.** Rock fragments larger than 2 feet (60 centimeters) in diameter.

**Calcareous soil.** A soil containing enough calcium carbonate (commonly combined with magnesium carbonate) to effervesce visibly when treated with cold, dilute hydrochloric acid.

**Channery soil.** A soil that is, by volume, more than 15 percent thin, flat fragments of sandstone, shale, slate, limestone, or schist as much as 6 inches along the longest axis. A single piece is called a fragment.

**Clay.** As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

**Clay film.** A thin coating of oriented clay on the surface of a soil aggregate or lining pores or root channels. Synonyms: clay coating, clay skin.

**Claypan.** A slowly permeable soil horizon that contains much more clay than the horizons above it. A claypan is commonly hard when dry and plastic or stiff when wet.

**Coarse fragments.** Mineral or rock particles 2 millimeters to 25 centimeters (10 inches) in diameter.



**Colluvium.** Soil material, rock fragments, or both moved by creep, slide, or local wash and deposited at the base of steep slopes.

**Complex, soil.** A map unit of two or more kinds of soil in such an intricate pattern or so small in area that it is not practical to map them separately at the selected scale of mapping. The pattern and proportion of the soils are somewhat similar in all areas.

**Compressible** (in tables). Excessive decrease in volume of soft soil under load.

**Concretions.** Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrated compounds or cemented soil grains. The composition of most concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are common compounds in concretions.

**Consistence, soil.** The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are-

*Loose.*-Noncoherent when dry or moist; does not hold together in a mass.

*Friable.*-When moist, crushes easily under gentle pressure between thumb and forefinger and can be pressed together into a lump.

*Firm.*-When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

*Plastic.*-When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

*Sticky.*-When wet, adheres to other material and tends to stretch somewhat and pull apart rather than to pull free from other material.

*Hard.*-When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

*Soft.*-When dry, breaks into powder or individual grains under very slight pressure.

*Cemented.*-Hard; little affected by moistening.

**Contour stripcropping (or contour farming).** Growing crops in strips that follow the contour. Strips of grass or close-growing crops are alternated with strips of clean-tilled crops or summer fallow.

**Control section.** The part of the soil on which classification is based. The thickness varies among different kinds of soil, but for many it is that part of the soil profile between depths of 10 inches and 40 or 80 inches.

**Corrosive.** High risk of corrosion to uncoated steel or deterioration of concrete.

**Cutbanks cave** (in tables). The walls of excavations tend to cave in or slough.

**Deferred grazing.** Postponing grazing or arresting grazing for a prescribed period.

**Depth to rock.** Bedrock is too near the surface for the specified use.

**Drainage class** (natural). Refers to the frequency and duration of periods of saturation or partial saturation during soil formation, as opposed to altered drainage, which is commonly the result of artificial drainage or irrigation but may be caused by the sudden deepening of channels or the blocking of drainage outlets. Seven classes of natural soil drainage are recognized:

*Excessively drained.*-Water is removed from the soil very rapidly. Excessively drained soils are commonly very coarse textured, rocky, or shallow. Some are steep. All are free of the mottling related to wetness.

*Somewhat excessively drained.*-Water is removed from the soil rapidly. Many somewhat excessively drained soils are sandy and rapidly pervious. Some are shallow. Some are so steep that much of the water they receive is lost as runoff. All are free of the mottling related to wetness.

*Well drained.*-Water is removed from the soil readily, but not rapidly. It is available to plants throughout most of the growing season, and wetness does not inhibit growth of roots for significant periods during most growing seasons. Well drained soils are commonly medium textured. They are mainly free of mottling.

*Moderately well drained.*-Water is removed from the soil somewhat slowly during some periods. Moderately well drained soils are wet for only a short time during the growing season, but periodically for long enough that most mesophytic crops are affected. They commonly have a slowly pervious layer within or directly below the solum, or periodically receive high rainfall, or both.

*Somewhat poorly drained.*-Water is removed slowly enough that the soil is wet for significant periods during the growing season. Wetness markedly restricts the growth of mesophytic crops unless artificial drainage is provided. Somewhat poorly drained soils commonly have a slowly pervious layer, a high water table, additional water from seepage, nearly continuous rainfall, or a combination of these.

*Poorly drained.*-Water is removed so slowly that the soil is saturated periodically during the growing season or remains wet for long periods. Free water is commonly at or near the surface for long enough during the growing season that most mesophytic crops cannot be grown unless the soil is artificially drained. The soil is not continuously saturated in layers directly below plow depth. Poor drainage results from a high water table, a slowly pervious layer within the profile, seepage, nearly continuous rainfall, or a combination of these.

*Very Poorly drained.*-Water is removed from the soil so slowly that free water remains at or on the surface during most of the growing season. Unless the soil is artificially drained, most mesophytic crops

cannot be grown. Very poorly drained soils are commonly level or depressed and are frequently ponded. Yet, where rainfall is high and nearly continuous, they can have moderate or high slope gradients.

**Drainage, surface.** Runoff, or surface flow of water, from an area.

**Eolian soil material.** Earthy parent material accumulated through wind action; commonly refers to sandy material in dunes or to loess in blankets on the surface.

**Erosion.** The wearing away of the land surface by water, wind, ice, or other geologic agents and by such processes as gravitational creep.

*Erosion* (geologic). Erosion caused by geologic processes acting over long geologic periods and resulting in the wearing away of mountains and the building up of such landscape features as flood plains and coastal plains. Synonym: natural erosion.

*Erosion* (accelerated). Erosion much more rapid than geologic erosion, mainly as a result of the activities of man or other animals or of a catastrophe in nature, for example, fire, that exposes the surface.

**Excess alkali** (in tables). Excess exchangeable sodium in the soil. The resulting poor physical properties restrict the growth of plants.

**Excess fines** (in tables). Excess silt and clay in the soil. The soil does not provide a source of gravel or sand for construction purposes.

**Excess lime** (in tables). Excess carbonates in the soil that restrict the growth of some plants.

**Excess salts** (in tables). Excess water-soluble salts in the soil that restrict the growth of most plants.

**Fallow.** Cropland left idle in order to restore productivity through accumulation of moisture. Summer fallow is common in regions of limited rainfall where cereal grains are grown. The soil is tilled for at least one growing season for weed control and decomposition of plant residue.

**Fast intake** (in tables). The rapid movement of water into the soil.

**Favorable.** Favorable soil features for the specified use.

**Field moisture capacity.** The moisture content of a soil, expressed as a percentage of the oven-dry weight, after the gravitational, or free, water has drained away; the field moisture content 2 or 3 days after a soaking rain; also called normal field capacity, normal moisture capacity, or capillary capacity.

**Fine textured soil.** Sandy clay, silty clay, and clay.

**Flagstone.** A thin fragment of sandstone, limestone, slate, shale, or (rarely) schist, 6 to 15 inches (15 to 37.5 centimeters) long.

**Flooding.** The temporary covering of soil with water from overflowing streams, runoff from adjacent slopes, and tides. Frequency, duration, and probable dates of occurrence are estimated. Frequency is expressed as none, rare, occasional, and frequent.

None means that flooding is not probable; rare that it is unlikely but possible under unusual weather conditions; occasional that it occurs on an average of once or less in 2 years; and frequent that it occurs on an average of more than once in 2 years. Duration is expressed as very brief if less than 2 days, brief if 2 to 7 days, and long if more than 7 days. Probable dates are expressed in months; November-May, for example, means that flooding can occur during the period November through May. Water standing for short periods after rainfall or commonly covering swamps and marshes is not considered flooding.

**Flood plain.** A nearly level alluvial plain that borders a stream and is subject to flooding unless protected artificially.

**Foot slope.** The inclined surface at the base of a hill.

**Forage.** Plant material used as feed by domestic animals. Forage can be grazed or cut for hay.

**Forb.** Any herbaceous plant not a grass or a sedge.

**Frost action** (in tables). Freezing, and thawing of soil moisture. Frost action can damage roads, buildings and other structures, and plant roots.

**Genesis, soil.** The mode of origin of the soil. Refers especially to the processes or soil-forming factors responsible for the formation of the solum, or true soil, from the unconsolidated parent material.

**Grassed waterway.** A natural or constructed waterway, typically broad and shallow, seeded to grass as protection against erosion. Conducts surface water away from cropland.

**Gravel.** Rounded or angular fragments of rock up to 3 inches (2 millimeters to 7.5 centimeters) in diameter. An individual piece is a pebble.

**Gravelly soil material.** Material that is 15 to 50 percent, by volume, rounded or angular rock fragments, not prominently flattened, up to 3 inches (7.5 centimeters) in diameter.

**Ground water** (geology). Water filling all the unblocked pores of underlying material below the water table.

**Gully.** A miniature valley with steep sides cut by running water and through which water ordinarily runs only after rainfall. The distinction between a gully and a rill is one of depth. A gully generally is an obstacle to farm machinery and is too deep to be obliterated by ordinary tillage; a rill is of lesser depth and can be smoothed over by ordinary tillage.

**Habitat.** The natural abode of a plant or animal; refers to the kind of environment in which a plant or animal normally lives, as opposed to the range or geographical distribution.

**Horizon, soil.** A layer of soil, approximately parallel to the surface, having distinct characteristics produced by soil-forming processes. The major horizons of mineral soil are as follows:

*O horizon.* An organic layer of fresh and decaying plant residue at the surface of a mineral soil.

*A horizon*.-The mineral horizon at or near the surface in which an accumulation of humified organic matter is mixed with the mineral material. Also, a plowed surface horizon, most of which was originally part of a B horizon.

*A2 horizon*.-A mineral horizon, mainly a residual concentration of sand and silt high in content of resistant minerals as a result of the loss of silicate clay, iron, aluminum, or a combination of these.

*B horizon*.-The mineral horizon below an A horizon. The B horizon is in part a layer of transition from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics such as (1) accumulation of clay, sesquioxides, humus, or a combination of these; (2) prismatic or blocky structure; (3) redder or browner colors than those in the A horizon; or (4) a combination of these. The combined A and B horizons are generally called the solum, or true soil. If a soil does not have a B horizon, the A horizon alone is the solum.

*C horizon*.-The mineral horizon or layer, excluding indurated bedrock, that is little affected by soil-forming processes and does not have the properties typical of the A or B horizon. The material of a C horizon may be either like or unlike that in which the solum formed. If the material is known to differ from that in the solum, the Roman numeral II precedes the letter C.

*R layer*.-Consolidated rock beneath the soil. The rock commonly underlies a C horizon, but can be directly below an A or a B horizon.

**Hydrologic soil groups.** Refers to soils grouped according to their runoff-producing characteristics. The chief consideration is the inherent capacity of soil bare of vegetation to permit infiltration. The slope and the kind of plant cover are not considered, but are separate factors in predicting runoff. Soils are assigned to four groups. In group A are soils having a high infiltration rate when thoroughly wet and having a low runoff potential. They are mainly deep, well drained, and sandy or gravelly. In group D, at the other extreme, are soils having a very slow infiltration rate and thus a high runoff potential. They have a claypan or clay layer at or near the surface, have a permanent high water table, or are shallow over nearly impervious bedrock or other material. A soil is assigned to two hydrologic groups if part of the acreage is artificially drained and part is undrained.

**Increasers.** Species in the climax vegetation that increase in amount as the more desirable plants are reduced by close grazing. Increasers commonly are the shorter plants and the less palatable to livestock.

**Infiltration.** The downward entry of water into the immediate surface of soil or other material, as contrasted

with percolation, which is movement of water through soil layers or material.

**Infiltration rate.** The rate at which water penetrates the surface of the soil at any given instant, usually expressed in inches per hour. The rate can be limited by the infiltration capacity of the soil or the rate at which water is applied at the surface.

**Irrigation.** Application of water to soils to assist in production of crops. Methods of irrigation are-

**Border**.-Water is applied at the upper end of a strip in which the lateral flow of water is controlled by small earth ridges called border dikes, or borders.

**Basin**.-Water is applied rapidly to nearly level plains surrounded by levees or dikes.

**Controlled flooding**.-Water is released at intervals from closely spaced field ditches and distributed uniformly over the field.

**Corrugation**.-Water is applied to small, closely spaced furrows or ditches in fields of close-growing crops or in orchards so that it flows in only one direction.

**Furrow**.-Water is applied in small ditches made by cultivation implements. Furrows are used for tree and row crops.

**Sprinkler**.-Water is sprayed over the soil surface through pipes or nozzles from a pressure system.

**Subirrigation**.-Water is applied in open ditches or tile lines until the water table is raised enough to wet the soil.

**Wild flooding**.-Water, released at high points, is allowed to flow onto an area without controlled distribution.

**Large stones** (in tables). Rock fragments 3 inches (7.5 centimeters) or more across. Large stones adversely affect the specified use of the soil.

**Leaching.** The removal of soluble material from soil or other material by percolating water.

**Light textured soil.** Sand and loamy sand.

**Loam.** Soil material that is 7 to 27 percent clay particles, 28 to 50 percent silt particles, and less than 52 percent sand particles.

**Loess.** Fine grained material, dominantly of silt-sized particles, deposited by wind.

**Low strength.** The soil is not strong enough to support loads.

**Medium textured soil.** Very fine sandy loam, loam, silt loam, or silt.

**Metamorphic rock.** Rock of any origin altered in mineralogical composition, chemical composition, or structure by heat, pressure, and movement. Nearly all such rocks are crystalline.

**Mineral soil.** Soil that is mainly mineral material and low in organic material. Its bulk density is greater than that of organic soil.

**Minimum tillage.** Only the tillage essential to crop production and prevention of soil damage.

**Moderately coarse textured (moderately light textured) soil.** Sandy loam and fine sandy loam.

**Moderately fine textured soil.** Clay loam, sandy clay loam, and silty clay loam.

**Morphology, soil.** The physical makeup of the soil, including the texture, structure, porosity, consistence, color, and other physical, mineral, and biological properties of the various horizons, and the thickness and arrangement of those horizons in the soil profile.

**Mottling, soil.** Irregular spots of different colors that vary in number and size. Mottling generally indicates poor aeration and impeded drainage. Descriptive terms are as follows: abundance-*few, common, and many*, size-*fine, medium, and coarse*; and contrast-*faint, distinct, and prominent*. The size measurements are of the diameter along the greatest dimension. *Fine* indicates less than 5 millimeters (about 0.2 inch); *medium*, from 5 to 15 millimeters (about 0.2 to 0.6 inch); and *coarse*, more than 15 millimeters (about 0.6 inch).

**Munsell notation.** A designation of color by degrees of the three simple variables-hue, value, and chroma. For example, a notation of 10YR 6/4 is a color of 10YR hue, value of 6, and chroma of 4.

**Neutral soil.** A soil having a pH value between 6.6 and 7.3.

**Parent material.** The great variety of unconsolidated organic and mineral material in which soil forms. Consolidated bedrock is not yet parent material by this concept.

**Pedon.** The smallest volume that can be called "a soil." A pedon is three dimensional and large enough to permit study of all horizons. Its area ranges from about 10 to 100 square feet (1 square meter to 10 square meters), depending on the variability of the soil.

**Percolation.** The downward movement of water through the soil.

**Percolates slowly (in tables).** The slow movement of water through the soil adversely affecting the specified use.

**Permeability.** The quality of the soil that enables water to move downward through the profile. Permeability is measured as the number of inches per hour that water moves downward through the saturated soil. Terms describing permeability are:

Very slow .....	less than 0.06 inch
Slow .....	0.06 to 0.20 inch
Moderately slow .....	0.2 to 0.6 inch
Moderate .....	0.6 inch to 2.0 inches
Moderately rapid .....	2.0 to 6.0 inches
Rapid .....	6.0 to 20 inches
Very rapid .....	more than 20 inches

**Phase, soil.** A subdivision of a soil series based on features that affect its use and management. For example, slope, differences in slope, stoniness, and thickness.

**pH value.** A numerical designation of acidity and alkalinity in soil. (See Reaction, soil.)

**Piping (in tables).** Formation of subsurface tunnels or pipelike cavities by water moving through the soil.

**Plasticity index.** The numerical difference between the liquid limit and the plastic limit; the range of moisture content within which the soil remains plastic.

**Plastic limit.** The moisture content at which a soil changes from a semisolid to a plastic state.

**Profile, soil.** A vertical section of the soil extending through all its horizons and into the parent material.

**Rangeland.** Land on which the potential natural vegetation is predominantly grasses, grasslike plants, forbs, or shrubs suitable for grazing or browsing. It includes natural grasslands, savannas, many wetlands, some deserts, tundras, and areas that support certain forb and shrub communities.

**Range condition.** The present composition of the plant community on a range site in relation to the potential natural plant community for that site. Range condition is expressed as excellent, good, fair, or poor, on the basis of how much the present plant community has departed from the potential.

**Range site.** An area of range where climate, soil, and relief are sufficiently uniform to produce a distinct kind and amount of native vegetation.

**Reaction, soil.** A measure of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is described as precisely neutral in reaction because it is neither acid nor alkaline. The degree of acidity or alkalinity is expressed as-

.....pH	
Extremely acid .....	Below 4.5
Very strongly acid .....	4.5 to 5.0
Strongly acid .....	5.1 to 5.5
Medium acid .....	5.6 to 6.0
Slightly acid .....	6.1 to 6.5
Neutral .....	6.6 to 7.3
Mildly alkaline .....	7.4 to 7.8
Moderately alkaline .....	7.9 to 8.4
Strongly alkaline .....	8.5 to 9.0
Very strongly alkaline .....	9.1 and higher

**Relief.** The elevations or inequalities of a land surface, considered collectively.

**Residuum (residual soil material).** Unconsolidated, weathered, or partly weathered mineral material that accumulates over disintegrating rock.

**Rock fragments.** Rock or mineral fragments having a diameter of 2 millimeters or more; for example, pebbles, cobbles, stones, and boulders.

**Rooting depth (in tables).** Shallow root zone. The soil is shallow over a layer that greatly restricts roots.

**Runoff.** The precipitation discharged into stream channels from an area. The water that flows off the surface of the land without sinking into the soil is called surface runoff. Water that enters the soil before reaching surface streams is called groundwater runoff or seepage flow from ground water.

**Sand.** As a soil separate, individual rock or mineral fragments from 0.05 millimeter to 2.0 millimeters in diameter. Most sand grains consist of quartz. As a soil textural class, a soil that is 85 percent or more sand and not more than 10 percent clay.

**Sandstone.** Sedimentary rock containing dominantly sand-size particles.

**Sedimentary rock.** Rock made up of particles deposited from suspension in water. The chief kinds of sedimentary rock are conglomerate, formed from gravel; sandstone, formed from sand; shale, formed from clay; and limestone, formed from soft masses of calcium carbonate. There are many intermediate types. Some wind-deposited sand is consolidated into sandstone.

**Seepage (in tables).** The movement of water through the soil. Seepage adversely affects the specified use.

**Shale.** Sedimentary rock formed by the hardening of a clay deposit.

**Shrink-swell.** The shrinking of soil when dry and the swelling when wet. Shrinking and swelling can damage roads, dams, building foundations, and other structures. It can also damage plant roots.

**Silica.** A combination of silicon and oxygen. The mineral form is called quartz.

**Silt.** As a soil separate, individual mineral particles that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). As a soil textural class, soil that is 80 percent or more silt and less than 12 percent clay.

**Slope.** The inclination of the land surface from the horizontal. Percentage of slope is the vertical distance divided by horizontal distance, then multiplied by 100. Thus, a slope of 20 percent is a drop of 20 feet in 100 feet of horizontal distance.

**Slope classes.** The slope classes in this survey area are as follows:

Nearly level .....	0 to 2 percent
Gently sloping .....	2 to 4 percent
Sloping .....	4 to 8 percent
Moderately steep .....	8 to 20 percent
Steep .....	20 to 35 percent
Very steep .....	35 to 65 percent

**Sloughed till.** Water-saturated till that has flowed slowly downhill from its original place of deposit by glacial ice. It may rest on other till, on glacial outwash, or on a glaciolacustrine deposit.

**Slow intake (in tables).** The slow movement of water into the soil.

**Small stones (in tables).** Rock fragments less than 3 inches (7.5 centimeters) in diameter. Small stones adversely affect the specified use of the soil.

**Sol.** A natural, three-dimensional body at the earth's surface. It is capable of supporting plants and has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

**Solum.** The upper part of a soil profile, above the C horizon, in which the processes of soil formation are active. The solum in soil consists of the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and plant and animal activities are largely confined to the solum.

**Stones.** Rock fragments 10 to 24 inches (25 to 60 centimeters) in diameter.

**Stony.** Refers to a soil containing stones in numbers that interfere with or prevent tillage.

**Stripcropping.** Growing crops in a systematic arrangement of strips or bands which provide vegetative barriers to wind and water erosion.

**Structure, soil.** The arrangement of primary soil particles into compound particles or aggregates. The principal forms of soil structure are platy (laminated), prismatic (vertical axis of aggregates longer than horizontal), columnar (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. Structureless soils are either *single grained* (each grain by itself, as in dune sand) or massive (the particles adhering without any regular cleavage, as in many hardpans).

**Stubble mulch.** Stubble or other crop residue left on the soil or partly worked into the soil. It protects the soil from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

**Subsoil.** Technically, the B horizon; roughly, the part of the solum below plow depth.

**Substratum.** The part of the soil below the solum.

**Subsurface layer.** Technically, the A2 horizon. Generally refers to a leached horizon lighter in color and lower in content of organic matter than the overlying surface layer.

**Summer fallow.** The tillage of uncropped land during the summer to control weeds and allow storage of moisture in the soil for the growth of a later crop. A practice common in semiarid regions, where annual precipitation is not enough to produce a crop every year. Summer fallow is frequently practiced before planting winter grain.

**Surface soil.** The soil ordinarily moved in tillage, or its equivalent in uncultivated soil, ranging in depth from 4 to 10 inches (10 to 25 centimeters). Frequently designated as the "plow layer," or the "Ap horizon."

**Terrace.** An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surface runoff so that it can soak into the soil or flow slowly to a prepared outlet without harm. A terrace in a field is generally built so that the field can be farmed. A terrace intended mainly for drainage has a deep channel that is maintained in permanent sod.

**Terrace (geologic).** An old alluvial plain, ordinarily flat or undulating, bordering a river, a lake, or the sea.

**Texture, soil.** The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportion of fine particles, are sand, loamy sand, sandy loam, loam, silt, silt loam, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay, and clay. The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

**Thin layer.** Otherwise suitable soft material too thin for the specified use.

**Topsoil (engineering).** Presumably a fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress roadbanks, lawns, and gardens.

**Upland (geology).** Land at a higher elevation, in general, than the alluvial plain or stream terrace; land above the low lands along streams.

**Unstable fill.** Risk of caving or sloughing in banks of fill material.

**Variant, soil.** A soil having properties sufficiently different from those of other known soils to justify a new series name, but the limited geographic soil area does not justify creation of a new series.

**Water table.** The upper limit of the soil or underlying rock material that is wholly saturated with water.

*Water table, apparent.* A thick zone of free water in the soil. An apparent water table is indicated by the level at which water stands in an uncased borehole after adequate time is allowed for adjustment in the surrounding soil.

*Water table, artesian.* A water table under hydrostatic head, generally beneath an impermeable layer. When this layer is penetrated, the water level rises in an uncased borehole.

*Water table, perched.* A water table standing above an unsaturated zone. In places an upper, or perched, water table is separated from a lower one by a dry zone.

**Weathering.** All physical and chemical changes produced in rocks or other deposits at or near the earth's surface by atmospheric agents. These changes result in disintegration and decomposition of the material.

**Wilting point (or permanent wilting point).** The moisture content of soil, on an oven-dry basis, at which a plant (specifically sunflower) wilts so much that it does not recover when placed in a humid, dark chamber.